1977

Variables that have influenced sugar beet acreage in Canada.

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VARIABLES THAT HAVE INFLUENCED SUGAR BEET ACREAGE IN CANADA

by

Joseph Byrne

A Thesis
submitted to the Faculty of Graduate Studies
through the Department of Geography in partial
fulfillment of the requirements for
the Degree of Master of Arts at
The University of Windsor

Windsor, Ontario, Canada
1977

ABSTRACT

An overall aim of this study is to identify, locate and explain increases or decreases of sugar beet acreage since 1945 in Canada. The study is divided into three parts. Part 1 provides discussion of major events and policies surrounding the development of a partly successful sugar beet industry in Canada and describes the current situation. Part 2 examines the effect of a selected set of variables on sugar beet acreage in Canada. In Part 3 an assessment of spatial dynamics of sown acreage is made.

Correlation analysis was used to assess the strength of the relationships between the dependent variable and each of the independent variables. The study helps to proportion the effect of factors that have influenced sugar beet acreage in Canada.

Metric measures for land area are not used in this study because Canadian farmers are generally more familiar with acres than hectares.

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CHAPTER I

INTRODUCTION

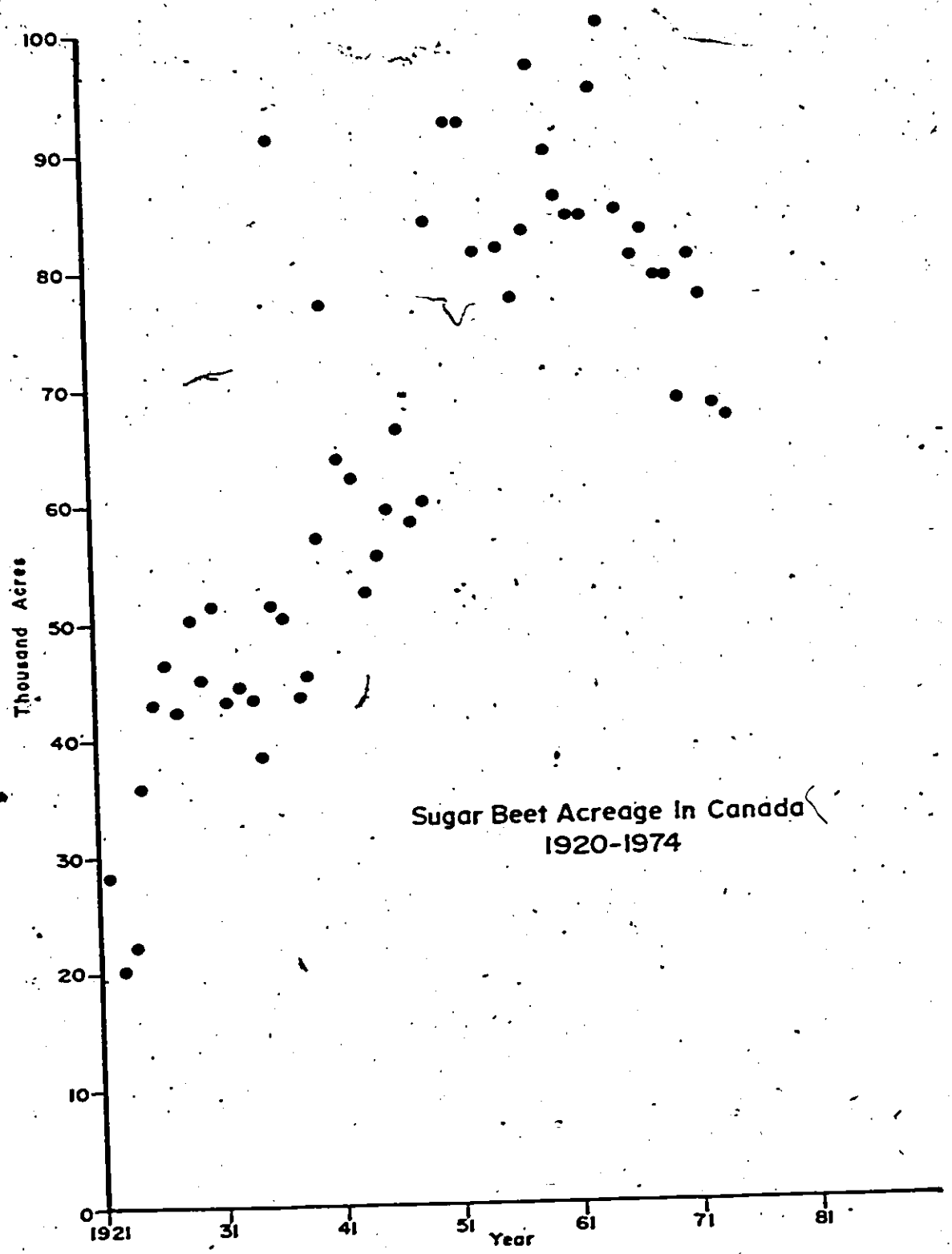
Canada has been a net importer of sugar despite good growing conditions for sugar beets in several large areas of the country. Domestic production of approximately 130,000 tons of beet sugar in 1972 satisfied about 15 percent of the total amount used by the country (Miller, 1972). By 1974 Canadian grown sugar beets supplied less than 10 percent of the home market (Food Prices Review Board, 1975). E. S. Eaton (1967), L. C. Odette, et al. (1971), and others have noted that sugar beet acreages in Canada have tended to fluctuate from year to year but in general have declined since 1958 (see Fig. 1).

There are good agroclimatic conditions for sugar beets not only in the present growing districts of Quebec, Manitoba and Alberta but also in many other areas in a wide belt across the whole of Southern Canada (Tacke, et al., 1963) (Fig. 4, 5). Little research has been done to determine why the sugar beet industry has not expanded to those areas.

Purposes and Objectives

The primary aim of this study is to identify, locate and explain increases or decreases of sugar beet acreage

FIGURE 1



Sugar Beet Acreage In Canada
1920-1974

Source: International Sugar Organization

since 1945 in Canada. The study is divided into three parts. Part One discusses major events and policies surrounding the development of a partly successful sugar beet industry in Canada and describes the current situation. Variables that have influenced sugar beet acreages in Canada are discussed in Part Two. Part Three consists of an assessment of spatial dynamics of sown acreage.

Definitions

manufacturer refers to sugar beet (rather than sugar cane) refiner.

plant population is the number of plants per unit of area.

roots refers to sugar beet roots and is used for convenience to differentiate between sugar beet roots and tops.

sugar is any product of 99 percent sucrose content (Odette, 1971).

sugar factory is an establishment that produces sugar from sugar beets (Odette, 1971).

sugar refinery refers to an establishment that produces sugar from sugar cane (Odette, 1971).

Sugar Cane

Sugar cane is grown in tropical and sub tropical regions. The plant requires 9 to 24 months to mature. It is a perennial grass-like plant that can grow on a wide range of well drained soils. When optimal rainfall of 80 to 90 inches per year is obtained sugar cane yields an average of

five metric tons of sugar per acre (Fig. 2).

Sugar Beets

Sugar beets are biennial plants, grown in temperate climates. A good average crop of sugar beets produces 1 3/4 metric tons of sugar per acre. They do best on deep loam soils of high humus content and require a 170 to 200 day growing season (Fig. 3).

The longer growing season and higher yields of sugar can provide more stability to cane farming. However, this affords less flexible response to changing supply and demand factors. Approximately 60 percent of the world's centrifugal sugar supplies are derived from sugar cane (Table 1).

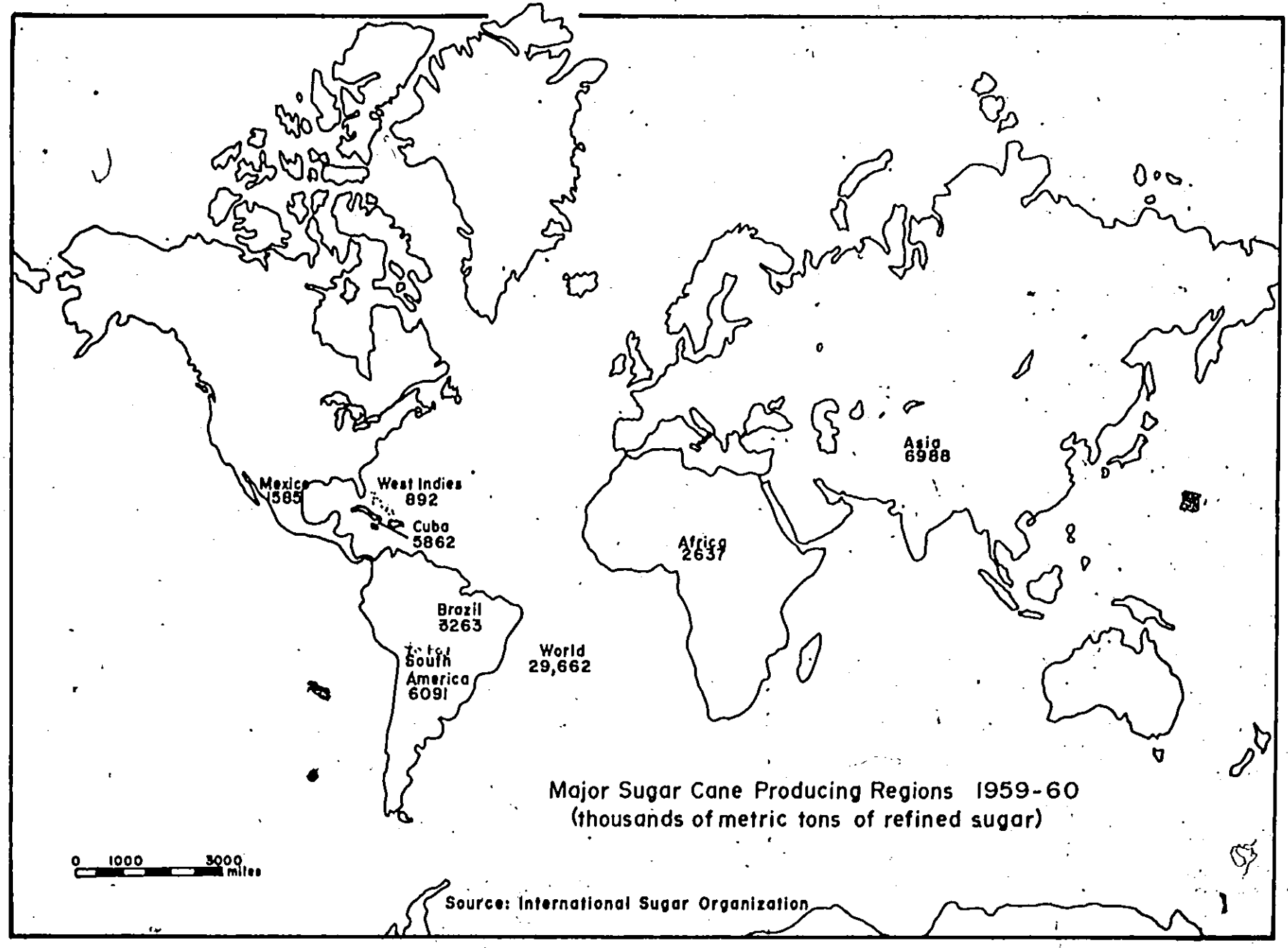
TABLE 1

Source of World Sugar

Year	Sugar from cane	Sugar from beets
1937-38	66%	34%
1950-51	63%	37%
1960-61	57%	43%
1969-70	59%	41%
1974-75	60%	40%

Source: International Sugar Organization*

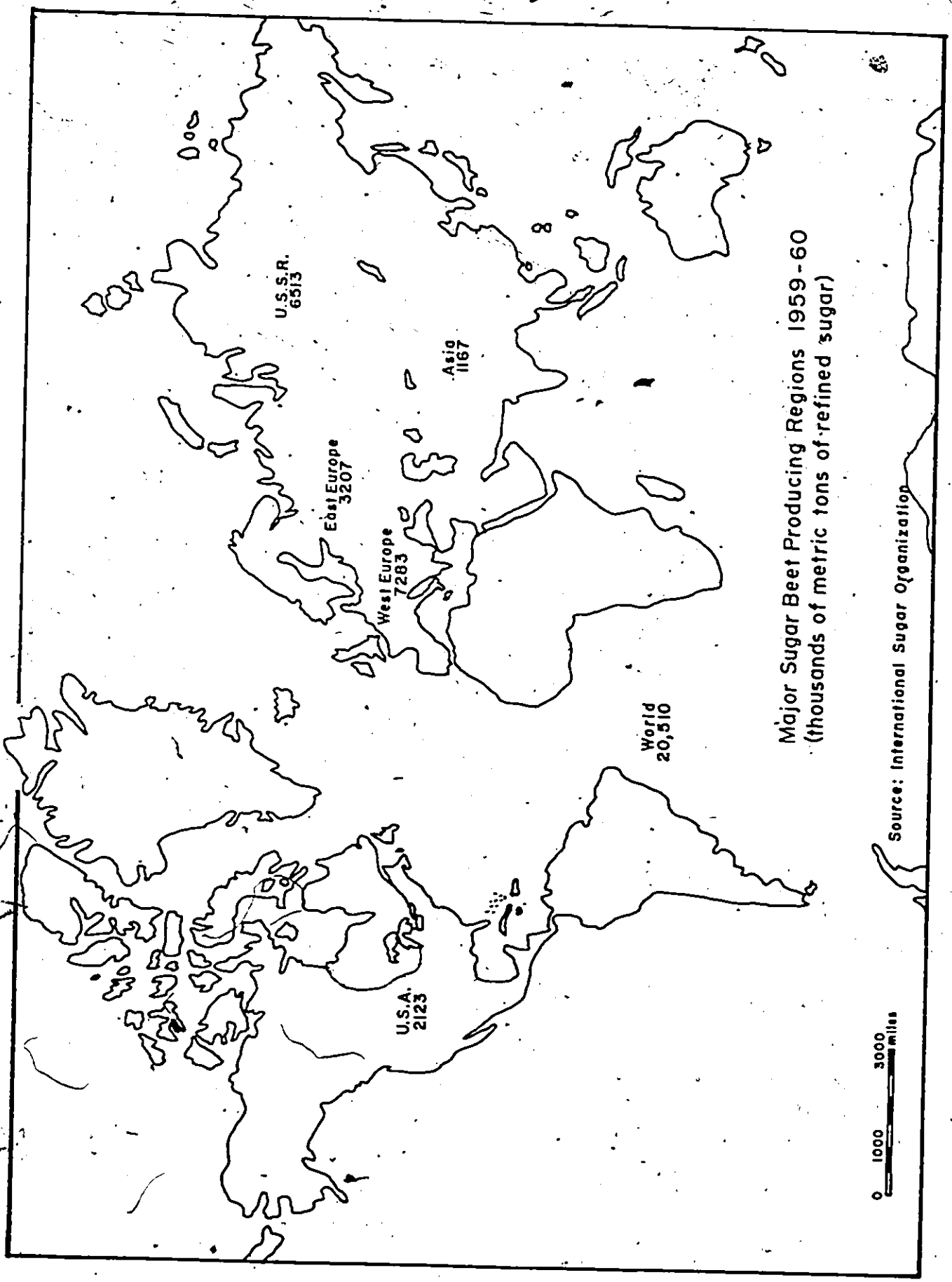
* A further comparison of sugar beet and sugar cane production can be found in various International Sugar organization publications including World Sugar Economy Volumes 1 and 2; the Sugar Yearbooks and others. Beet and cane production by year and by country is given.



Major Sugar Cane Producing Regions 1959-60
(thousands of metric tons of refined sugar)

FIGURE II

FIGURE 3


U.S.S.R.
6513
East Europe
3207
West Europe
7283
Asia
1167
World
20,510
U.S.A.
2123
0
1000
3000
miles
Major Sugar Beet Producing Regions 1959-60
(thousands of metric tons of refined sugar)
Source: International Sugar Organization

CHAPTER II

REVIEW OF LITERATURE

Much has been written on various aspects of the Canadian sugar industry but little indication is given concerning the nature of the relationship between economic variables and Canadian sugar beet acreage. Similarly the spatial dynamics of sown acreages have not been explored in much detail.

E. F. Tacke (1963) has noted that there are large regions in Canada that are agroclimatically suitable for sugar beet growing. The Canadian Task Force on Agriculture (1969) has agreed that there are differences in the extent to which various economic variables influence the acreages of different sugar producing areas. E. S. Eaton (1967) and R. T. Miller (1972) have described that pattern in spatial terms. Eaton has noted that while the demand for sugar in the prairie provinces is largely supplied by domestic producers most of the sugar consumed in Canada is imported. Miller has agreed with the theme by noting that a sharp rise in London Daily Price of sugar during the latter months of 1971 has not resulted in a rise in 1972 prairie sugar beet acreage. Similarly Britnell and Fowke (1962) have noted that Ontario sugar beets had to compete with other profitable

cash crops to a greater degree than they did in other provinces.

The importance of factory location is discussed by Goranson (1966), who has asserted that due to quantities of weight that are lost in beet processing it could be feasible to locate a sugar factory in a sparsely populated region providing that there are good conditions for beet growing. Bolton and Aylesworth (1968) and others have made good progress in developing farming techniques that increase yield of sugar per unit of area. The Federal Task Force on Agriculture published a report in 1969 which stated that subsidies should not be given sugar beet producers during periods of unfavourable conditions. The recommendation was made because since 1960 there had been ample low priced free market sugar available to Canada.

Other studies develop similar themes to the ones that have been cited. Two important themes that can be extracted from the literature are that Canada is and has been a net importer of sugar despite ideal growing conditions for sugar beets in a large portion of the country. Secondly, different factors have governed the intensity of sugar beet production in the different growing areas of the country. This study offers evidence to explain the two themes.

CHAPTER III

SUGAR BEET INDUSTRY IN CANADA

1880-1940

Canada's earliest sugar beet manufacturers were unable to overcome economic problems. Factories that had been opened during the 1880's were quickly closed at Coaticook, Berthier and Farnham in Quebec (Committee of the National Development Bureau, 1932). Rapid closures of plants built in 1902 at Wiarton, Dresden and Berlin (Blue, 1909) occurred despite a government subsidy to producers of one half cent per pound of root between the years 1903 and 1907 (Committee of the National Development Bureau, 1932).

Successful sugar beet factories were built at Wallaceburg (Blue, 1909) and Chatham (Allen, 1976) in 1902. Both locations had ideal agroclimatic conditions for sugar beets and access to low cost water transportation (Fig. 2).

Indicative of the uncertainty in the sugar beet industry is the case of Raymond, Alberta where a sugar beet factory was dismantled in 1917, fourteen years after it was built. A new plant was constructed at Raymond in 1925 (Committee of the National Development Bureau, 1932). Due to larger capacity and updated technology the new plant operated successfully for many years.

1940-1975

During World War II many countries were unable to obtain sufficient supplies of sugar. Sugar was rationed in Canada as in many other countries. An immediate effect of the shortages was a post war trend towards self-sufficiency and long term sugar agreements between countries. World markets were divided into zones of restricted entry (Tarriff Board, 1971). The United States of America, for example, allocated imports to Cuba, Puerto Rico, Hawaii and the Philippines.

Canadian sugar beet area approximately doubled during the 1950's (International Sugar Organization, 1963), as shown in Table 2. This expansion was accompanied by post 1940 openings of sugar beet factories at Picture Butte, Taber, Fort Gary and St. Hillaire.

During the mid 1960's Canadian sugar factories produced about 15 to 20 percent of the sugar consumed in Canada (Eaton, 1967). At present domestically produced sugar supplies 10 percent of demand. The decline is described further by two trends. Firstly, production of sugar in Canada fell by six percent during the 1960's but consumption increased by 39 percent during the same decade (Table 2). Secondly, world sugar production rose steadily until 1969 (Tarriff Board, 1971). The large world surplus of low priced sugar seems to have been an important factor in the closing of the sugar factory at Chatham, Ontario in 1968.

FIGURE 4

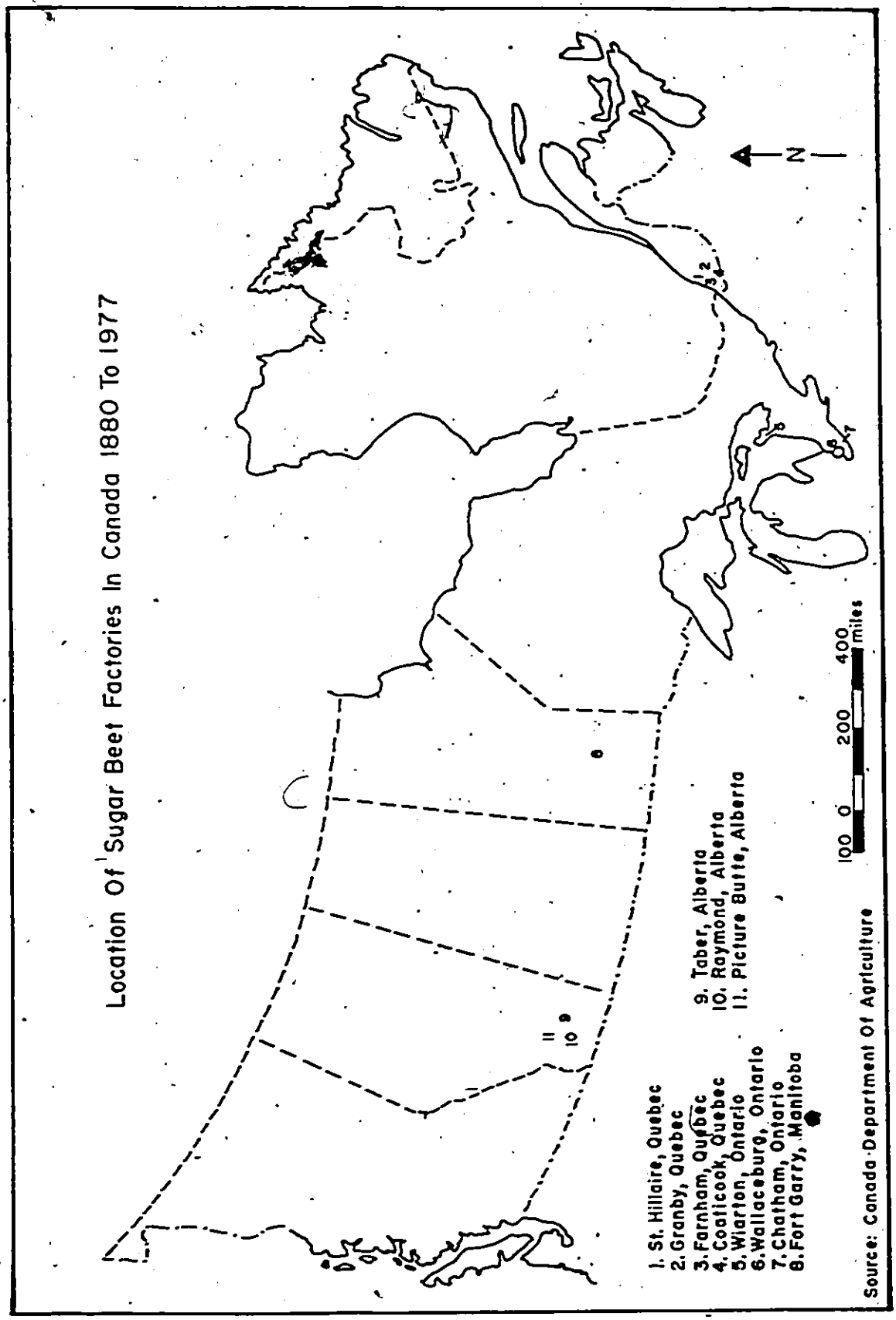

Location Of Sugar Beet Factories In Canada 1880 To 1977
N
1. St. Hillaire, Quebec
2. Granby, Quebec
3. Farnham, Quebec
4. Coaticook, Quebec
5. Wiarton, Ontario
6. Wallaceburg, Ontario
7. Chatham, Ontario
8. Fort Garry, Manitoba
9. Taber, Alberta
10. Raymond, Alberta
11. Picture Butte, Alberta
100 0 200 400 miles
Source: Canada Department Of Agriculture

TABLE 2

Sugar Beet Acreage in Canada and the Provinces, 1945-1976

Year	Canada	Alberta	Manitoba	Quebec	New Brunswick	Ontario
1945-46	59,283	30,344	9,827	1,314		17,687
1946-47	66,619	29,564	11,499	2,163		23,293
1947-48	58,405	29,257	8,910	1,635		18,603
1948-49	60,065	29,198	9,531	2,879		18,457
1949-50	84,216	32,367	15,562	6,237		30,050
1950-51	101,496	36,152	20,198	11,869		33,277
1951-52	92,920	32,595	19,074	9,738		31,513
1952-53	92,588	36,741	16,392	7,892		31,563
1953-54	81,949	34,701	17,455	7,022		22,771
1954-55	90,453	36,966	23,510	6,473		23,504
1955-56	81,908	36,393	20,755	6,035		18,725
1956-57	78,786	36,150	22,808	5,670		14,158
1957-58	83,743	36,694	21,419	5,889		19,741
1958-59	97,800	38,308	21,955	5,949		31,588
1959-60	90,453	35,144	17,500	4,503		33,306
1960-61	86,128	41,379	25,068	5,423		14,258
1961-62	84,927	39,538	21,141	7,895		16,353
1962-63	84,677	40,277	21,565	10,182		12,653
1963-64	95,223	39,755	28,100	10,557		16,811
1964-65	101,312	42,122	29,820	10,628		18,742
1965-66	85,023	38,899	25,917	9,257		10,950
1966-67	81,272	37,884	23,045	8,418		11,925
1967-68	83,305	33,507	26,898	8,776		14,124
1968-69	79,666	39,206	29,079	11,381		
1969-70	79,227	38,867	31,062	9,298		
1970-71	68,771	36,733	33,022	9,016		
1971-72	81,096	32,945	30,876	8,175		
1972-73	77,610	43,325	28,098	6,187		
1973-74	68,640	38,204	24,670	5,766		
1974-75	67,538	34,917	26,921	5,700		
1975-76	79,485	39,535	31,923	8,027	770	

- in acres

Source: International Sugar Organization

Sugar Agreements

The Food Prices Review Board (1974) has recognized that five sugar agreements have had substantial effect on world sugar circulation and prices. These include the Commonwealth Sugar Agreement, United States Sugar Policy, The Cuban Agreement, The Canada-West Indies Trade Agreement and the International Sugar Agreement.

1. The Commonwealth Sugar Agreement

The Commonwealth Sugar Agreement grew out of Britain's wartime bulk buying arrangement. The United Kingdom gained stability of price and supply while exporting members were assured a stable market for their sugar (Food Prices Review Board, 1974). The agreement has since been circumvented by Britain's recent entry into the European Economic Community.

2. United States Policy

The Food Prices Review Board summed up the American policy correctly by stating that "each year the secretary of agriculture assumes the quantity of sugar that the market requires and decides the proportion to be met by domestic production and from foreign sources (1974). In turn both domestic producers and suppliers are put on quotas. The system offers a theme of stability to American prices and supplies that is similar that which the United Kingdom had obtained from the Commonwealth agreement.

3. The Cuban Agreement

The bulk of Cuban sugar is traded to the Soviet Union

and other European socialist countries. Most of the sales are made on a barter system.

Agreements Involving Canada

Sugar prices in Canada have tended to be highly irregular because of the instability of free market sugar prices. Canada has never signed a long term agreement for sugar that would guarantee a fixed price (the reasons not being altogether clear).

Canada has been a member of the International Sugar Agreement and currently has an agreement with several West Indies countries. Neither of these agreements have stipulated fixed prices.

1. The International Sugar Agreement

Canada became a member of the International Sugar Agreement in 1968. The accord was aimed at raising the level of international trade in sugar, at maintaining a stable price for sugar and at providing access to markets of developed countries for poor countries. The agreement, terminated in 1973, required that Canada operate its internal policies so as not to provide incentives to domestic sugar production beyond a level representing twenty percent of consumption (Tarriff Board, 1971). It further stipulated that Canada not import from a non member country when the price was below 3.25 U.S. cents per pound and annual imports from non member countries were not to exceed the

previous year average from non member countries when the price was between 3.25 and 5.25 cents per pound (Tarriff Board, 1971).

2. The Canada-West Indies Agreement

The agreement is still in effect. It offers Canada a preferential margin of one dollar per one hundred pounds of sugar but has had very little affect on trade in recent years.

CHAPTER IV

VARIABLES INFLUENCING SUGAR BEET ACREAGE IN CANADA

The purpose of part two is to discuss variables that have influenced sugar beet acreage in Canada. The variables were chosen as a result of a reconnaissance study of pertinent data and from a review of literature.

It was hypothesized that in a period of decreasing sugar beet acreage in Canada (1961-1975) there would be negative correlation between sugar beet acreage in Canada and each of world sugar price, production and consumption, Canadian sugar consumption, federal subsidies and processor's cost of purchasing sugar beets from farmers. It was further hypothesized that in a period of increasing sugar beet acreage in Canada (1947-60), there is a positive relationship between Canadian sown acreage and each of world sugar production and consumption, Canadian consumption and processor's cost to purchase sugar beets.

The relationship between sugar beet acreage and each of availability of sugar factories, competition from other crops, farm yields, agroclimatic conditions - especially soils and climate, labour and transportation costs are also discussed.

Data

Each of the variables are measured in ratio scale data, obtained from the International Sugar Council, government agencies and government documents. The data was cross checked from one reference to a second and found to be reliable.

In this study a one year time lag is allowed for between dependent variable and independent variable. For example, data for sugar beet acreage from 1947 to 1975 corresponds to data for the period 1946-1974. If the correlation coefficients were found to be 0.50 the coefficient 0.50 would be said to describe data for time period 1947 to 1975.

General Method of Analysis

Correlation analysis was used to measure the strength of the relationship between sugar beet acreage and each of world sugar price, production and consumption, Canadian consumption, processor's cost to purchase beets and farm yields. In this context, correlation analysis contributes a lot to answering the question as to which factors effect the dynamics of sown acreage of sugar beets and to what extent. Correlation techniques measure the strengths between two variables accurately and allow a clear presentation of the findings.

Each of the seven variables were graphed with sugar

acreage in order that the trends are more clearly illustrated. These graphs are included in the appendices.

Findings

1. World sugar production

A correlation coefficient of -0.78 describes the relationship between Canadian sugar beet acreage and world production of sugar between 1961 and 1975. This compares to a correlation coefficient of +0.62 for the same two variables for data of 1947 to 1960 period. The recent tendency of Canadian sugar beet acreage to decrease as world sugar production increased was a divergence from the pre 1960 trend of positive correlation.

A post World War II trend towards home production of sugar caused expansion of both Canadian sugar beet acreage and world sugar production during the late 1940's and the 50's. The trend had been inspired by wartime sugar shortages and accompanying ration policies. World sugar production expanded at a fairly constant rate after 1960 but Canadian sugar beet acreage fluctuated and decreased. The trend may be reflective of Canada's inability to produce sugar as cheaply as major exporting nations.

2. World sugar consumption

The two tailed nature of the relationship between world sugar consumption and Canadian sugar beet acreage is illustrated in Appendix I. Correlation analysis describes

TABLE 3

Data Used In Correlation Analysis

Year	Canadian Sugar Beet Acreage	World Sugar Production	World Sugar Consumption	Canadian Consumption
1945-46		19,362	24,114	458,400
1946-47	66,619	18,185	24,114	458,400
1947-48	58,405	22,000	24,114	458,400
1948-49	60,065	24,544	24,114	458,400
1949-50	84,216	28,110	27,376	655,000
1950-51	101,496	29,160	29,404	660,000
1951-52	92,920	33,566	31,547	640,100
1952-53	92,588	36,087	33,436	673,200
1953-54	81,939	34,985	35,769	659,400
1954-55	90,453	38,771	37,293	697,400
1955-56	81,905	38,354	38,773	730,300
1956-57	78,786	39,705	41,507	751,300
1957-58	83,743	41,644	42,614	739,100
1958-59	97,800	44,420	44,823	802,100
1959-60	90,453	49,606	46,914	815,800
1960-61	86,128	50,172	48,000	800,000
1961-62	84,927	54,780	53,278	800,199
1962-63	84,677	51,477	53,679	900,014
1963-64	95,223	52,614	54,846	908,416
1964-65	101,312	60,218	55,097	907,404
1965-66	85,023	64,885	59,109	963,565
1966-67	81,272	64,052	61,107	968,809
1967-68	83,305	66,386	63,042	1,082,256
1968-69	79,666	66,829	66,295	1,021,124
1969-70	79,227	65,636	68,410	1,073,456
1970-71	68,771	72,896	72,118	1,073,870
1971-72	81,096	73,952	74,386	1,054,107
1972-73	77,610	75,745	76,007	1,036,504
1973-74	68,640	77,993	78,694	1,211,765
1974-75	67,538	in 000's of	in 000's of	in metric
	in acres	metric tons	metric tons	tons

Source: Records of the International Sugar Organization

TABLE 4

Data Used in Correlation Analysis

Year	London Daily Sugar Price (Aug.)	New York Price	Average Farm Yields in Can.	Federal Subsidies
1945-46		3.42	10.44	
1946-47		4.61	11.05	
1947-48		5.46	10.37	
1948-49		5.05	10.48	
1949-50		5.31	10.20	
1950-51		5.43	10.99	
1951-52		5.56	10.39	
1952-53		5.76	11.05	
1953-54		5.79	10.99	
1954-55		5.59	11.10	
1955-56		5.45	11.98	
1956-57		5.59	11.33	
1957-58		5.75	12.58	
1958-59		5.77	13.55	
1959-60	27.31	5.74	13.70	0.00
1960-61	28.48	5.80	12.76	1.40
1961-62	25.68	5.67	13.02	1.93
1962-63	25.59	5.83	13.06	0.00
1963-64	71.70	7.56	13.50	0.00
1964-65	51.13	6.28	12.81	3.15
1965-66	21.51	6.12	13.44	6.38
1966-67	17.87	6.36	14.35	4.83
1967-68	22.15	6.65	12.98	5.41
1968-69	21.83	7.52	13.79	3.23
1969-70	33.83	7.75	13.61	2.29
1970-71	40.06	8.07	13.33	0.86
1971-72	46.18	8.52	14.99	0.00
1972-73	72.63	9.09	13.78	0.00
1973-74	99.46	10.29	14.48	0.00
	in pounds per long ton	in U.S. cents per pound	in short tons	in Canadian dollars per standard ton

Source: Records of the International Sugar Organization. Statistics for federal subsidy were obtained from the 1973 Agricultural Outlook Conference, Published by Canada Agriculture.

the trend in terms of a +0.56 coefficient for the 1947 to 1960 period and a -0.75 coefficient for the 1961 to 1975 period.

Both world production and consumption of sugar have been of steadily increasing volumes during the two aforementioned time periods. Production of sugar world wide has been significantly influenced by world wide disappearance rates of sugar. When the net figure for world production and consumption of sugar is compared with Canadian sugar beet acreage there is a small positive correlation coefficient for both time periods.

3. World sugar price

The degree of correlation between world price of sugar and Canadian sugar beet acreage is indicated by a coefficient of -0.27* between the years 1961 and 1975. The correlation coefficient indicates a general trend of decreasing acreage in Canada during times of increased price. The coefficient is weakened by the fact that high world prices for sugar have tended to increase the competitive position of the Canadian sugar industry during the final two years of the study's time period.

The data for world sugar price was obtained from the average London daily index rather than the New York price because the London index best describes the price of free

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* Data was obtained from records of the International Sugar Organization.

market sugar. The New York price monitors a domestic condition. The London index did not quote a price between 1945 and 1956.

4. Canadian consumption of sugar

Steadily increased demand for sugar in Canada from 1946 to 1974 was accompanied by increased sugar beet acreage in Canada until the early 1960's. After 1960 there was an inverse relationship between the two variables. The two tailed relationship is described by a correlation coefficient of -0.68 for data from 1961 to 1975 and a coefficient of +0.69 between 1947 and 1960.

5. Federal Subsidy

Subsidy payments during periods of low world sugar prices have tended to keep sugar beet acreages at artificially high levels. A negative correlation coefficient of -0.20 between 1961 and 1975 indicates that larger subsidies have been needed to make Canada a competitive sugar producer with other nations.

TABLE 5

Support Level and Average Returns for Sugar Beets in Canada

Year	Support Level	Return From Processors	Federal Payment	Total Return
1960-61	13.18	11.77	1.40	13.18
1961-62	13.18	11.62	1.93	13.68
1962-63	13.71	18.64	0.00	18.64
1963-64	13.72	18.73	0.00	18.73
1964-65	13.72	11.62	3.15	14.77
1965-66	14.35	10.78	6.38	17.16
1966-67	14.35	11.00	4.83	15.83
1967-68	15.50	10.64	5.41	16.05
1968-69	15.98	14.00	3.23	17.23
1969-70	15.98	15.33	2.29	17.62
1970-71	15.98	16.64	0.86	17.40
1971-72	15.98	18.68	0.00	18.68
1972-73	nil	19.80	0.00	19.80
1973-74	nil	39.15	0.00	39.15

in dollars per standard ton*

Source: Canada Department of Agriculture - various publications. See: Agricultural Outlook Conference.

6. Processor's cost of purchasing sugar beets 1961 to 1975

A correlation coefficient of -0.34+ indicates that sugar beet acreage in Canada has decreased during years of high cost to the processor of purchasing sugar beets from farmer. The cost is calculated in terms of price per standard ton of sugar and is exclusive of federal subsidy payments

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* A standard ton is equal to 250 pounds of refined sugar.

+ Data was obtained from Canada Department of Agriculture, see Table 5.

(see Appendix I).

7. Farm yields

Sugar yields in Canada have fluctuated from year to year though there has been a general trend of a slight increase from 1947 to 1975. A correlation coefficient of +0.24* for data from 1947 to 1960 indicates that farm yields have not had a significant influence on sugar beet acreage. The trend has changed slightly in recent years as indicated by a correlation coefficient of -0.18 for data from 1961 to 1975. Larger increases in yield are needed to improve Canada's ability to compete with cane producers of tropical regions.

Summary

The hypotheses, listed on page 16 are accepted. Negative correlation coefficients were found when sugar beet acreage was compared to each of world sugar price, production, and consumption, Canadian sugar consumption, federal subsidies, cost to processor purchasing sugar beets from farmers and farm yields for the time period 1961 to 1975. In each case, where data permitted comparison, there was a positive correlation coefficient for data of the 1947 to 1960 time period. (See Table 6) Increased demand for sugar is being met by world sugar producers rather than by Canada.

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* Data was obtained from International Sugar Organization records.

TABLE 6

Correlation Coefficients - Canadian Sugar Beet Acreage and Dependent Variables

Factor	Time Period	
	1947-1960	1961-1975
World sugar production	+0.62	-0.78
World sugar consumption	+0.56	-0.75
Canadian sugar consumption	+0.69	-0.68
Processor's cost to purchase beets	-	-0.34
World sugar price	-	-0.27
Federal subsidies	-	-0.20
Farm yields	+0.24	-0.18

Other Factors

Four other factors have influenced Canada's sugar beet acreage to a substantial degree though they are more spatial in nature than the aforementioned ones. They are availability of sugar factories, competition from other crops, agroclimatic conditions, labour and transportation costs.

1. Availability of sugar factories

The capacity of sugar factories in Canada is between 150,000 and 175,000 tons of refined sugar per annum depending on length of season and percent of sugar per raw ton of sugar beets. Sugar factories in Canada are currently running close to capacity. Additional capacity is needed before there can be substantial increases of sugar beet acreage.

Construction of a sugar beet factory is very costly. In a feasibility report to the Federal government in 1976, Z. Przygoda and Associates reported that based on 1975 construction costs an expenditure of 60 million dollars was required to build a factory with capacity of manufacturing 6,000 tons of sugar per day. If the plant were to operate 100 days per year sugar imports could be reduced by about 30 percent. This report suggests that the plant could repay the investment within ten years.

2. Competition from other crops

The best agroclimatic regions for sugar beets are also ideal regions for mixed farming. Farmers who have a wide variety of crops to choose from will grow sugar beets only when the profit margin is favourable when compared to other crops. An interview with the Minister of Agriculture in 1976 indicated that the Federal government was hesitant to encourage an increase of sugar acreage at the expense of corn or soybean acreage or other agricultural commodities that Canada imports. Table 7 indicates the average per acre returns acquired from various crops grown in selected regions of Canada, 1974–1976.

TABLE 7

Average Per Acre Returns

Region	Crop	Yield (per acre)	Price $	Income - $ (per acre)
SW Ontario - Essex, Kent, Lambton	Field corn	80 bushels	2.75	220.00
	Soy beans	30 bushels	6.50	195.00
	Soft wheat	60 bushels	3.75	225.00
	Sweet corn	4 1/2 tons	60.00	270.00
	Green peas	2 tons	150.00	300.00
	Tomatoes	20 tons	75.00	1,500.00
East of London	White beans	20 cwts.	20.00	400.00
	Wheat	50 bushels	3.75	162.00
	Oats	70 bushels	1.50	105.00
	Field corn	75 bushels	2.75	192.25
	Sweet corn	4 tons	60.00	240.00
Southern Alberta	Hard wheat	40 bushels	4.00	160.00
	Oats	65 bushels	1.50	97.50
	Barley	50 bushels	2.00	100.00
	Hay	5 tons.	25.00	125.00
	Sugar beets	15 tons	25.00	375.00
Southern Manitoba	Wheat	35 bushels	4.00	140.00
	Oats	55 bushels	1.50	82.50
	Barley	45 bushels	2.00	90.00
	Hay	4 tons	25.00	100.00
	Sweet corn	3 1/2 tons	60.00	210.00
	Sugar beets	11 tons	25.00	275.00
Quebec Eastern Townships	Oats	50 bushels	1.50	75.00
	Hay	4 tons	25.00	100.00
	Sweet corn	3 tons	60.00	180.00
	Sugar beets	15 tons	25.00	375.00

3. Labour and Transportation costs

Labour

Labour costs represent a large portion of the total expenditure required to raise a crop of sugar beets. Technological advancements have reduced the required amounts

of hand labaur. Labour costs are similar in each of the present growing areas. Problems of availibility of labour have been largely alleviated by imports of help.

Transportation

Differences in the freight rates required to haul sugar from factory to market are indicated in Table 8 where transport costs are based on 1970 rates.

TABLE 8

Transportation Costs

Destination of Sugar	Rail Cost-Freight Montreal	Toronto	Delivered Cost of Refined Sugar from: Montreal	Toronto
Ottawa	25½	42	9.86	10.22
Kingston	34	35	9.94	10.15
Peterborough	36	19½	9.96	10.00
Toronto	30½	0	9.93	9.80
Kitchener	59	27	10.19	10.07
Windsor	77	42	10.37	10.22
	cents/cwt.		cents/lb.	

	Vancouver	Taber	Winnipeg	
Vancouver	0	-	-	Delivered cost
Calgary	117	37	124	of refined
Edmonton	117	61	124	sugar from
Taber	130	-	-	sources in
Saskatoon	181	81	83	Canada was
Regina	181	74	62	not available
Winnipeg	186	-	-	
		cents/cwt.		

Source: Tariff Review Board.

Table 8 illustrates the competitive advantage of Interior Western Canada over the rest of Canada.

4. Agroclimatic conditions

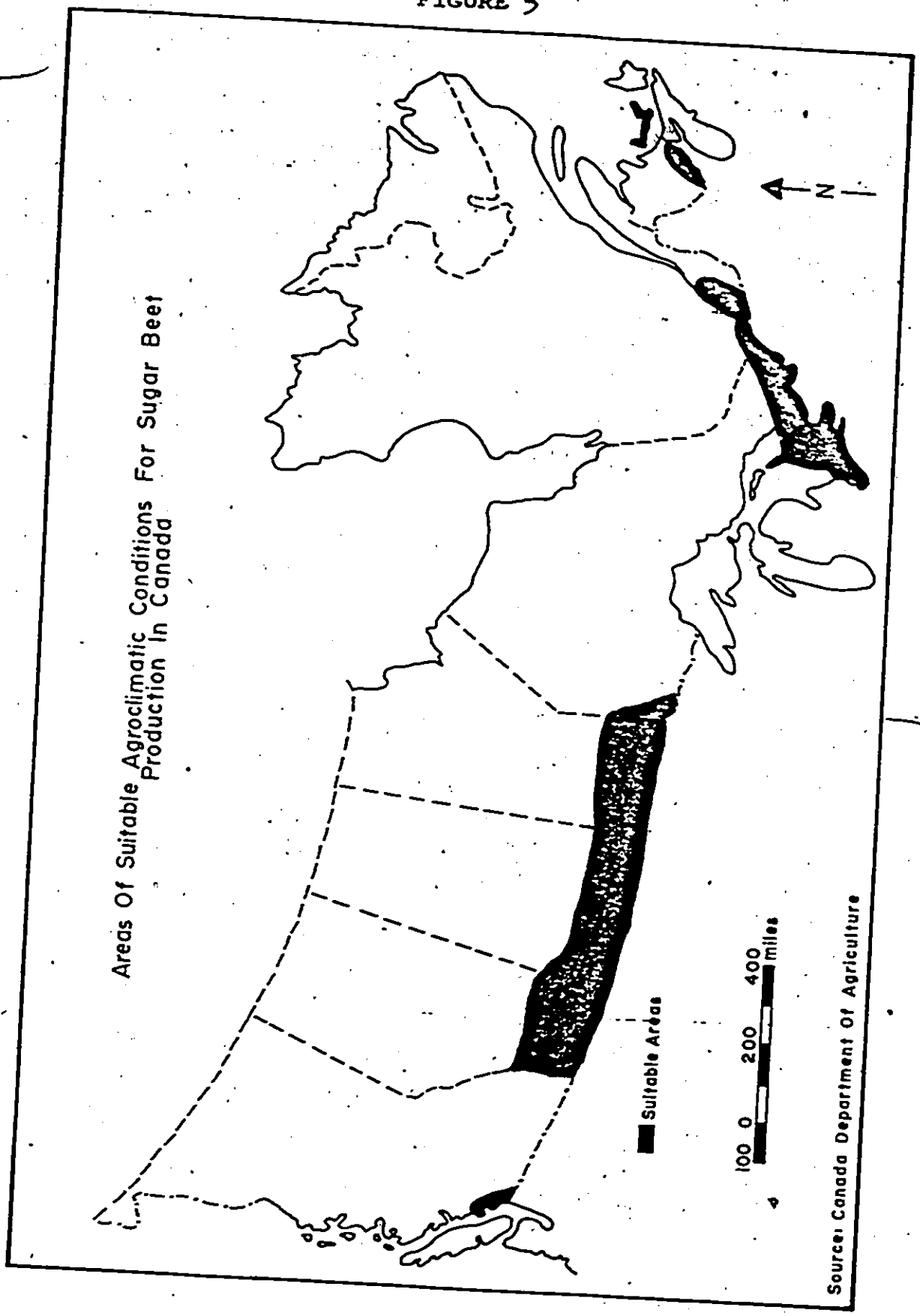
Soil

Sugar beets require a deep, well drained and permeable soil. Clay loams and sandy loams of high humus content are ideal for sugar beet culture. Barnyard manure is often used to ensure that ample organic material is in the soil. The optimum ph level is 6.8. Sugar beets respond much more readily to good physical soil conditions than most other crops grown in Canada. The sugar beet is very sensitive to improper soil conditions.

Climate

A growing season of 150 days and 30 inches of rainfall is sufficient to sustain a crop of sugar beets. In cooler climates the season can be lengthened by planting beet seeds at a very shallow depth (1/4 inch). Sugar beets can survive dry or wet conditions better than many agricultural crops. There are large expanses of land suitable for sugar beet production in the potato growing areas of Prince Edward Island and New Brunswick, the Eastern Townships of Quebec, most of Southern Ontario, southern Manitoba and southern Alberta. The potential for producing sugar beets in southern Saskatchewan depends upon irrigation and wise use of water resources. In British Columbia, the Fraser River Valley is agroclimatically suited to sugar beet production.

FIGURE 5


Areas Of Suitable Agroclimatic Conditions For Sugar Beet Production In Canada
N
Suitable Areas
100 0 200 400 miles
Source: Canada Department Of Agriculture

CHAPTER V

SUGAR BEET AREAS IN CANADA

The purpose of Part Three is to assess spatial dynamics of the sown sugar beet areas in Canada. The relationship between a selected set of variables and sugar beet acreages in each of the producing provinces are examined. A comparison of national and provincial trends is made. The method of analysis is similar to that used in the previous chapter, except that each of the selected variables are correlated with 1) Alberta sugar acreage, 2) Manitoba sugar acreage, 3) Quebec sugar acreage; figures indicating the various correlations are included in several appendices.

Alberta

Alberta is currently the largest sugar producing province in Canada. Nine hundred farmers produce 70,000 metric tons of sugar annually. The 35 to 40,000 acres of sugar beets produce approximately 600,000 metric tons of beet roots on an average.

Albertan sugar beet acreage is planted with special monogerm beet seed that was specially developed for prairie conditions. Most of the sugar beet seed is grown in the Fraser River delta near Vancouver.

Farmers obtain the seed from the sugar manufacturing company and agree to plant a certain acreage of land. The company agrees to purchase and market all of the sugar that the farmers produce. The farmers are paid 63 percent of revenue from sugar sales.

The sugar beet seed is planted during March, April or May. Farmers plant the seed in rows 20 to 25 inches apart and hope to get one healthy plant every 12 inches in the rows. The beets are fertilized, weeded and when necessary are irrigated. Harvest usually begins in late September.

Alberta's first successful year of sugar production was 1926 when 5394 acres were grown. The 30,344 acres grown in 1946 increased to 36,152 by 1951. It represented about 36 percent of the Canadian total acreage. In 1976, the 39,535 acres grown were approximately 50 percent of the total.

Research on sugar beets is conducted by the University of Alberta and the British Columbia Sugar Refiners. Researchers aim at improving the sugar producing efficiency by experimenting with alternative farming methods and through botanical work. The Canada Department of Agriculture also conducts independent research.

Correlation Analysis

Factor 1 - World sugar production

Correlation coefficients of +0.86 for the 1947 to 1960

period and of +0.29 for the 1961 to 1975 period is an indication that the strength of the relationship has decreased considerably during recent years.

Factor 2 - World sugar consumption

Correlation coefficients of +0.77 for the 1947 to 1960 period and of +0.22 for the 1961 to 1975 period describe the relationship between world sugar consumption and Albertan sown acreage. The trend is similar to that for world sugar production.

The growing of sugar beets in Alberta is much more strongly tied to the prairie market than to the world market. This is especially true of the 1961 to 1975 time period. Steadily increased prairie sugar consumption has accounted in large part for increased Alberta sugar acreage.

Factor 3 - Canadian sugar consumption

A correlation coefficient of +0.85 indicates a 1947 to 1960 trend of increased Canadian sugar consumption and increased Albertan sown acreages. Rapid growth occurred following the abandonment of sugar rationing policy which had held Canadian consumption to 458,000 tons per year between 1945 and 1948.

Alberta's geographical setting and agroclimatic advantage made it an ideal area for expanding home production. A correlation coefficient of +0.29 for the time period 1961 to 1975 indicates a lessened influence

of the aforementioned factors that caused earlier expansion (Appendix II).

The correlation coefficients differ from the Canadian situation as a whole. The inverse relationship between Canadian consumption and acreage as compared to the positive coefficient for the Albertan situation between 1961 and 1975 is a further indicator of Alberta's advantage over other Canadian regions that have produced sugar.

Factor 4 - London Daily Price

A correlation coefficient of 0.06 indicates that free market sugar prices have not greatly influenced Albertan sugar beet acreage between 1961 and 1975. This is largely due to the high cost of transporting imported sugar to the Alberta market. Canada's sugar beet acreage has been influenced to a greater degree.

Factor 5 - Processor's cost of purchasing sugar beets.

A slight inverse relationship between cost and sown acreage between 1947 to 1960 and a correlation coefficient of 0.23 for the 1961 to 1975 period indicates that purchase costs have not been of significant importance in the Albertan context. The processor's cost of purchasing sugar beets from the Albertan farmers has been stabilized by standard ton purchase contracts and by the afore described method of purchase. A standard ton of sugar has been set at 250 pounds. The same price is paid to farmers for actual sugar

regardless of number of tons of beet root required to produce the standard ton of sugar.

Factor 6 - Yields

Improved sugar yields in Alberta have not had significant influence on Alberta's sown acreage. There are correlation coeeficients of +0.35 for the earlier period and -0.10 for the later. Sugar yields per unit of land improved rapidly between 1947 and 1961. The improvement was caused by better irrigating and better seed. Increased yield by percent has been less rapid during recent years. Yield increases have led to total production increases rather than holding production constant by reducing sown acreage.

Competition from other crops

Sugar beets have provided Southern Alberta farmers with an excellent alternate crop and one that fits in nicely with crop rotational practices.

An irrigated farm in the Taber district might grow 50 acres of sugar beets, 70 acres of cereal grain, 40 acres of alfalfa, 40 acres of pasture and 40 acres of summer fallow. Sugar beets have yielded much higher profits than the competitive crops. Sugar beet acreage has not been seriously threatened by competition from the other crops.

Manitoba

Sugar beets were first grown in Manitoba in 1941 when 15,682 acres were sown. By 1951 acreage had increased to 20,198 which was about 22 percent of the Canadian total. The 31,923 acres grown in 1976 was over 37 percent of the Canadian total (See Table 2). Currently average production of 36,000 metric tons of sugar is produced by 550 farmers from 300,000 metric tons of beets on about 30,000 acres (International Sugar Organization, 1976).

All acreage is planted with monogerm beet seed, planted during May and early June. Plant populations used in Manitoba are similar to those in Alberta. Irrigation is not commonly used on sugar beets in Manitoba but as in Alberta fertilization and weed control programs are carefully administered.

The Manitoba harvest begins in late September and is usually completed within three to four weeks. Yields in Manitoba are commonly 4 to 5 tons per acre lower than in Alberta. Growers receive 63 percent of the proceeds from sugar sales.

Research is conducted by the agricultural branch of the British Columbia Sugar Refineries, the Canada Department of Agriculture and the University of Manitoba. Research focuses upon technological experimentation, fertilizer and weed control innovations and alternate farming practices.

Correlation Analysis

Factor 1 - World sugar production

World sugar production has had a one directional positive influence on Manitoba sugar beet acreage. Correlation coeeficients of +0.76 for the 1947 to 1960 period and +0.30 for the 1961 to 1975 period indicates that the strength of the relationship has decreased during recent years. The lower coefficient for the recent time period reflects an increased independence of Manitoba sugar acreage.

Though the trends for Manitoba and Alberta data are similar with regard to this factor, the strengths of correlation coefficients are different.

Factor 2 - World sugar consumption

Correlation coefficients of +0.82 for the 1947 to 1960 time period and of +0.30 for the 1961 to 1975 period indicates a decreasingly strong relationship between world consumption of sugar and Manitoba sugar beet acreage. This trend is similar as that for Factor 1. The Manitoba beet industry is strongly tied to the prairie market.

Factor 3 - London Daily Price 1961 to 1975.

A correlation coefficient of +0.14 indicates that world sugar price has not significantly influenced Manitoba sugar beet acreage. Manitoba sugar is marketed in Western Canada where high transportation makes imported

sugar less competitive with the domestic product (see Appendix III).

Factor 4 - Canadian consumption

There are high correlation coefficients between Canadian sugar consumption and Manitoba's sugar beet acreage. Coefficients of +0.81 for the 1947 to 1960 period and +0.46 for the 1961 to 1975 period indicates a strong reliance of the Manitoba sugar acreage on a domestic market.

Factor 5 - Processor's cost of purchasing sugar beets

A positive correlation coefficients of 0.23 for the 1961 to 1975 period is similar to that for Alberta data.

Factor 6 - Yields

Yields of sugar in Manitoba were of much greater importance during the 1947 to 1960 period than after 1960.

Correlation coefficients of +0.50 for the 1947 to 1960 period and of 0.04 for the 1961 to 1975 period indicates the trend (see Appendix III).

Each of the six factors that were correlated with Manitoba sugar acreage were characterized by lower correlation coefficients during the 1961 to 1975 period than during the 1947 to 1960 period. This indicates an increased stability within the Manitoba industry.

Competition from other crops

Manitoba's sugar beet industry is centred in the large, flat, black earth region known as Red River. Located within a 60 mile radius of Winnipeg the region is Manitoba's most productive and diversified agricultural area. The grain crops, alfalfa, pasture, and some corn and vegetables, while providing the farmers with a wide range of crop selection, have been unable to compete with sugar beets in terms of income per unit of land. Sugar beets have encouraged higher yields of grain crops while fitting in crop rotation programs. Farmers' willingness to grow sugar beets offers processors needed security of beet supplies.

Quebec

The Quebec sugar beet industry was revived in 1945 after earlier unsuccessful attempts at beet manufacturing were made during the late 1800's and early 1900's. The 2,700 acres grown in 1945 expanded to a peak of 11,869 acres in 1951. Acreage during the 1970 to 1976 period levelled off to an average of about 7,400 acres (see Table 2).

There were positive correlation coefficients for each of the variables that were compared to Quebec sugar acreage for the time period 1947 to 1960. Coefficients of +0.68 for Canadian consumption, +0.59 for farm yields

of sugar per unit of land, +0.11 for world consumption and +0.30 for world production describe the trends.

Data of the 1961-1975 period exhibits a different trend. Negative correlation coefficients were found for all variables that were compared to sugar beet acreage, except for processor's cost to purchase sugar beet from farmers. The coefficient for that comparison was +0.38. Negative coefficients were found for each of world sugar production (-0.39), world sugar consumption (-0.24), Canadian sugar consumption (-0.20), London Daily Price (-0.38), and farm yield (-0.31).

The correlation coefficients for the Quebec situation are typically weaker than those found for Canadian, Alberta or Manitoba acreages. Quebec government ownership of the sugar beet factory at St. Hillaire, Quebec and the heavy degree of provincial subsidization to the factory accounts for the lower coefficients.

Farmers in the Eastern Townships of Quebec grow mainly small grains, pasture and hay crops and some vegetables. Sugar beets have traditionally offered farmers high returns in comparison to these crops and abundant supplies of available labour have further encouraged farmers to grow sugar beets.

New Brunswick

Sugar beets were grown commercially in New Brunswick

for the first time in 1976. 770 acres of sugar beets, grown by 19 farmers in the heart of the province's potato growing area on the St. John River, were sold to an American sugar factory located 25 miles from the border at Easton, Maine. The factory is owned by a group of American farmers.

The situation is being closely monitored. The processors are seeking to establish a substantial acreage in New Brunswick and Prince Edward Island to increase stability of supply and volume. Federal and provincial government officials have received proposals to build a sugar factory in the Maritimes. Success or failure of the current experiment will have an influence on future proposals. Farm organizations anxious to find an alternate crop to potatoes are championing the sugar beet as an ideal crop for the region.

Ontario

Correlation analysis was not used with Ontario data since sugar beets have not been grown commercially in Ontario since 1968. Sugar acreage of 33,306 in 1960 was reduced to 14,124 by the final year's operation. The industry's final curtailment came in 1968 when the sugar factory at Chatham was closed.

Ontario produced Canada's highest sugar yields. There are ideal agroclimatic conditions for beets in Kent,

Lambton, Middlesex and Essex counties, where most of the Ontario beet crop was grown. Coupled with extensive research that had begun in the late 1890's at the University of Guelph and later at Canada Department of Agriculture Research stations, Ontario's sugar producing efficiency was unparalleled in Canada.

Trends

There was an inverse relationship between Ontario's 1947-1968 sugar beet acreage and each of world production and consumption of sugar and with Canadian sugar consumption. Ontario's decreasing acreage paralleled rising consumption and production rates. A similar trend of increased farm yields and decreased acreages occurred.

Competition from other crops

Competition from other crops is more severe in Southwestern Ontario than in the other beet producing regions of Canada. Southwestern Ontario agriculture supports crops that are profitably grown in other provinces such as feed grains, alfalfa, hay, silage corn and others. The region also supports many crops which have not been grown profitably in the rest of Canada. Soybeans, winter wheat, long season grain corn, tomatoes, cucumbers, sweet corn and peas are among a long list of specialty crops that thrive within the region. A farmer's willingness to grow a given crop is dependent upon economic

rent per unit of area and on return per man hour of labour. Higher prices are necessary to support a sugar industry in Southwestern Ontario than in the current sugar producing regions of Canada because of the competition factor. However this requires further study.

Imported sugar cane

Imported sugar cane, processed at large refineries in Toronto and Montreal is economically distributed to the major sugar markets of Ontario. The Ontario sugar beet industry has been severely curtailed by this factor.

Farmers' Attitudes

The sugar factory at Chatham had operated unprofitably for the five years prior to its closing in 1968. This was due in large part to an inability to secure sufficient supplies of sugar beets. The Canada and Dominion Sugar Company needed to contract at least 20,000 acres of beets in order to operate the factory profitably, but were only able to secure 75 percent of that amount from 1962-63 to 1967-68. In 1967, the company felt that they could not continue operations unless capacity supplies of sugar beets were obtained. Although 21,000 acres were contracted during the final year of operation only 14,124 were planted. Many farmers chose to ignore their sugar contracts because the spring had been wet and corn planting was a more time-efficient operation. Because of this the Canada and

Dominion Sugar Company decided that sugar supplies were unreliable and the plant at Chatham was closed in 1968.

CHAPTER VI

SUMMARY AND CONCLUSIONS

1. General

Canadian sugar acreage has declined during the 1960's and 1970's despite ideal agroclimatic conditions for sugar beets in large parts of the country. The reasons are many and varied but the general trend of decline is an indication that the domestic industry has not been able to compete with alternate sources of sugar.

Sugar beets grown in Alberta, Manitoba and Quebec produce about 10 percent of the sugar that is consumed in Canada. Ontario, once a large sugar producer no longer supports a beet sugar industry.

The Quebec sugar beet industry has received heavy financial support from the Quebec government. The factory at St. Hilaire is owned by the government and is the smallest of the four plants currently operating in Canada. Unlike the other factories, the Quebec plant markets most of its sugar in a semi-refined form to Redpath Sugar Company and to industrial users.

Government policy

The federal task force on agriculture concluded that

the Canadian sugar beet industry was not of sufficient value to continue subsidization policies. The Minister of Agriculture added in an interview in 1975 that the federal government does not wish to encourage expansion of sugar beet acreage if it would result in reduced domestic production of other imported agricultural commodities. Such competition from other crops is an important consideration in Southwestern Ontario where a wide range of crops are grown. In Alberta, Manitoba and Quebec sugar beets have complimented crop rotational practices.

3. Correlation analysis

Sugar beet acreages of Canada, Alberta, Manitoba and Quebec were correlated with each of world sugar production, price, Canadian consumption, processor's cost to purchase beets from farmers and average yields per unit area of land. Other factors were also discussed. Two time periods were compared in the study. They were 1947 to 1960 and 1961 to 1975. The following trends were observed.

1. Negative correlation coefficients were found when Canadian sugar beet acreage was compared to each of world sugar price, production and consumption, Canadian sugar consumption, federal subsidies, processor's cost to purchase sugar beets and farm yields, for the time period

1961 to 1975. In each case, where data permitted comparison, there was a positive correlation coefficient for data of the 1947 to 1960 time period.

2. Generally, Manitoba and Alberta sugar beet acreages correlated more strongly with each of the factors for data of the 1947 to 1960 period than for data of the 1961 to 1975 period.

3. The trend for Quebec was similar to that for Canada as a whole. There were positive correlation coefficients for data for the 1947 to 1960 time period but negative coefficients for the 1961 to 1975 period. Processor's cost to purchase beets was the sole exception.

4. The sugar beet industry in Alberta and Manitoba was better able to compete than was the industry in the rest of Canada during the recent time period. The predominance of negative correlation coefficients for the Canadian situation compares to the dominantly positive coefficients for Alberta and Manitoba.

5. World consumption and production of sugar correlated more strongly than any of the other factors with Canadian sugar beet acreage for data of the 1947 to 1960 period. Canadian consumption was also an important factor. World price, processor's cost of purchasing sugar beets from farmers, farm yields and federal subsidy payments were of lesser importance. Of these, processor's cost was the most important.

6. Correlation coefficients were generally stronger for Canada as a whole during the 1961 to 1975 period than for the earlier period.

7. During the 1961 to 1975 period, world price of sugar and farm yields correlated less strongly than the other factors when compared with Alberta and Manitoba sugar beet acreage. Canadian consumption was the single most important factor. World production, consumption and processor's cost to purchase beets from farmers were important factors.

8. For data of the 1961 to 1975 time period there were no negative coefficients when Manitoba sugar acreage was correlated with each of the 6 aforementioned factors. Negative coefficients occurred when Alberta acreage was correlated with farm yields.

9. During the entire 1947 to 1975 time period Canadian sugar consumption correlated strongly with each of Manitoba and Alberta acreage. World consumption and production also exhibited strong correlations. Farm yields and price per ton paid by the processor to the producer correlated much more strongly with Manitoba acreage than with Alberta acreage. More stable sugar yields in Alberta may account for this.

10. There are moderately strong positive correlation coefficients between Quebec sugar beet acreage and each of world production, consumption, Canadian sugar consumption,

and farm yields between 1947 to 1960. There are negative coefficients for the same factors for data of the 1961 to 1975 period.

Other Factors

11. The best agroclimatic conditions for sugar beets in Canada are found on the sandy loam soils of Southwestern Ontario. This area is also a major producer of other crops, The Ontario sugar industry, once the largest in Canada, was unable to compete profitably with some of these crops.

12. Present capacity of sugar factories in Canada is small. Costs of building new factories is high. Investors have not constructed sugar factories in recent years though several feasibility reports have been studied. This has been due in large part to the fluctuations of sugar prices.

13. Freight rates to transport refined sugar from refinery to market has an important influence on the spatial distribution of sown acreage. In inland areas, especially Western Canada, freight rates are higher than in the water serviced regions of Canada. During years of low world sugar prices, this factor has been very important in making sugar beets grown in Western Canada competitive with imported sugar.

In general, world sugar production, consumption and Canadian sugar consumption had greater influence on sugar beet acreage in each of Canada, Alberta and Manitoba than

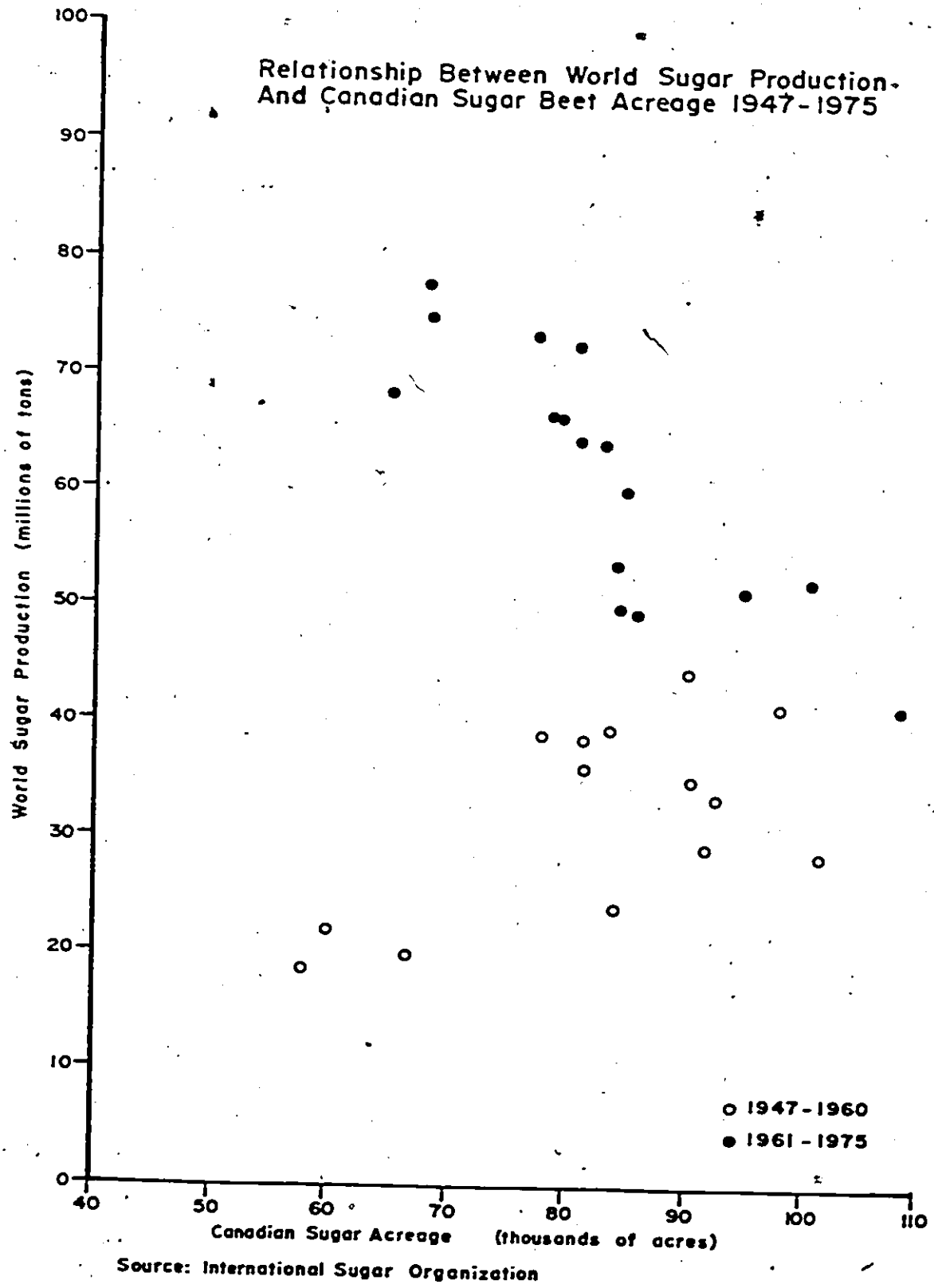
did the other factors. In Quebec, Canadian consumption and farm yields were the most important factors.

A complete list of the correlation coefficients and significance levels is given for Canada and the provinces in Appendix V.

APPENDIX I

Variables Influencing Sugar Beet Acreage in Canada

FIGURE 6



Source: International Sugar Organization

FIGURE 7

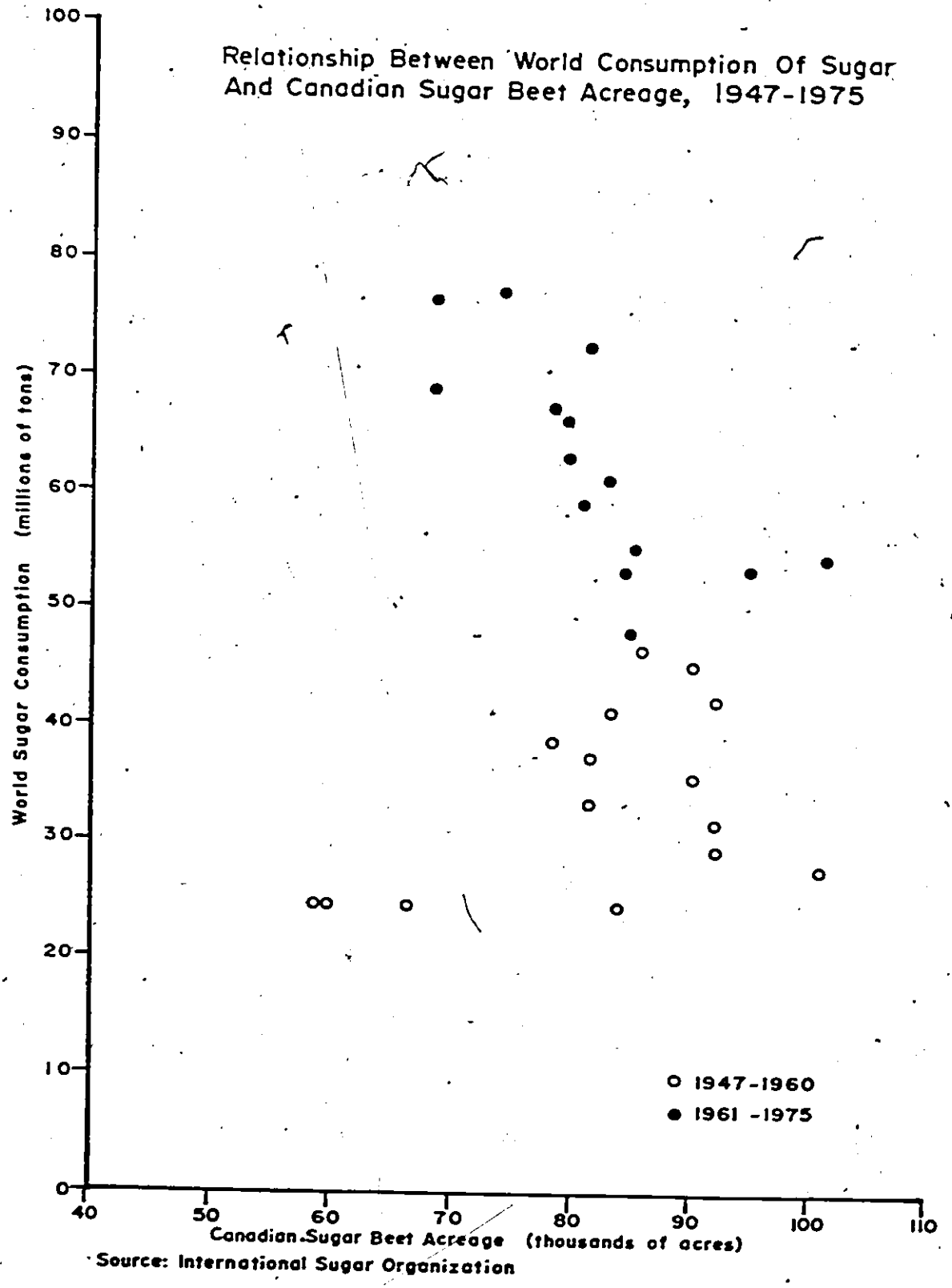

Relationship Between World Consumption Of Sugar And Canadian Sugar Beet Acreage, 1947-1975
World Sugar Consumption (millions of tons)
100
90
80
70
60
50
40
30
20
10
0
40
50
60
70
80
90
100
110
Canadian Sugar Beet Acreage (thousands of acres)
1947-1960
1961 -1975
Source: International Sugar Organization

FIGURE 8

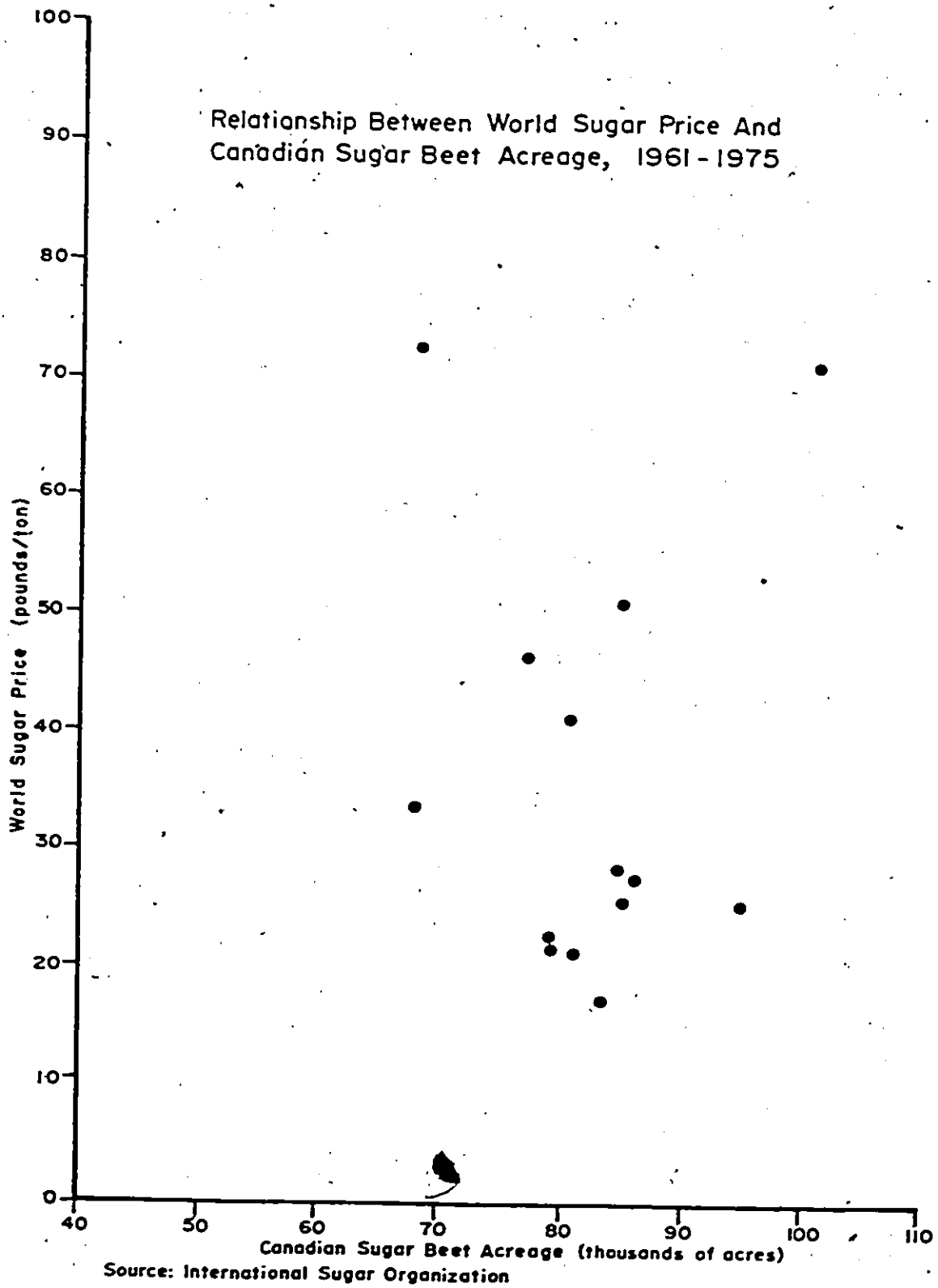
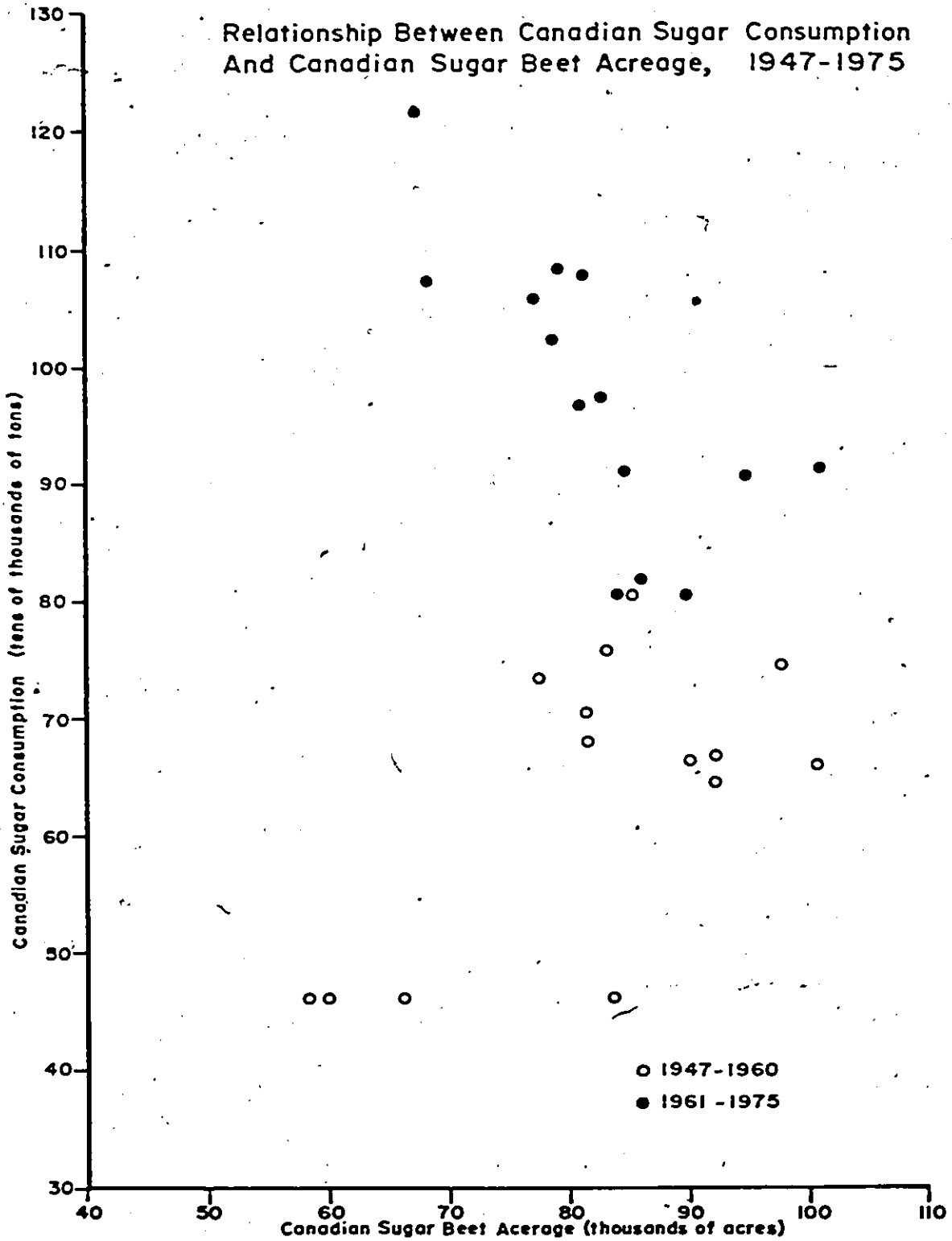
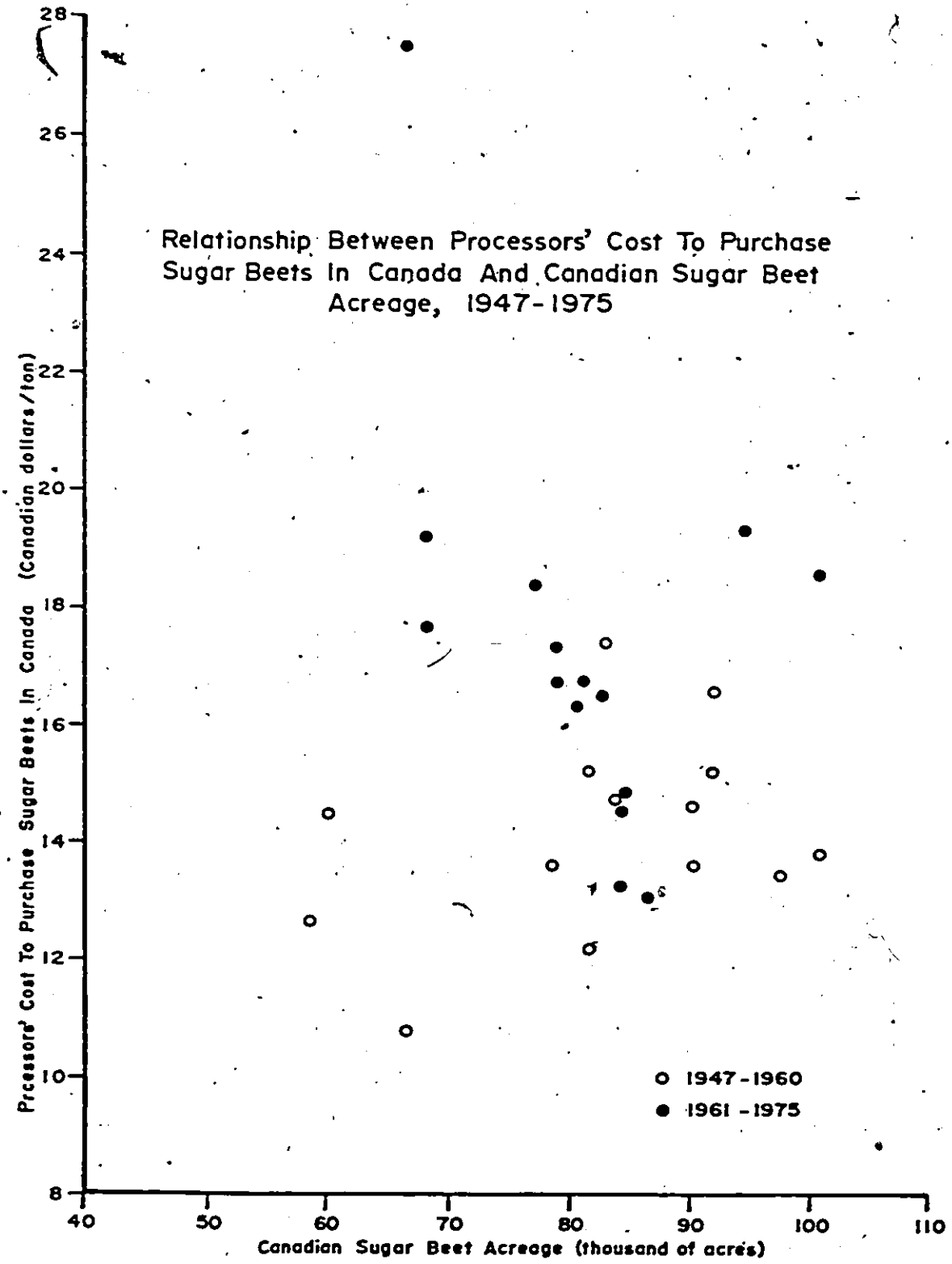

Relationship Between World Sugar Price And Canadian Sugar Beet Acreage, 1961 - 1975
World Sugar Price (pounds/ton)
100
90
80
70
60
50
40
30
20
10
0
40
50
60
70
80
90
100
110
Canadian Sugar Beet Acreage (thousands of acres)
Source: International Sugar Organization

FIGURE 9



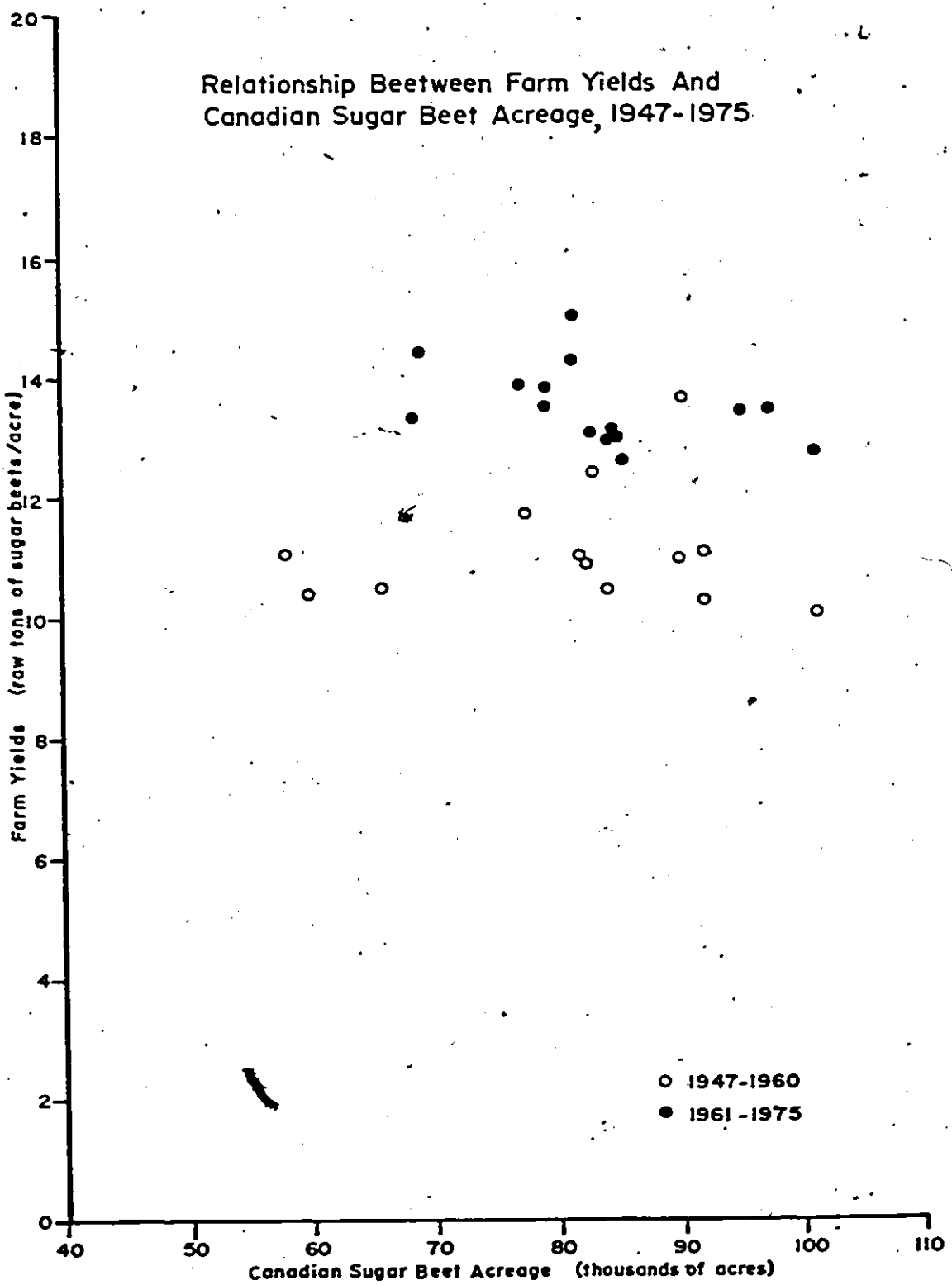
Source: International Sugar Organization

FIGURE 10



Source: International Sugar Organization

FIGURE 11



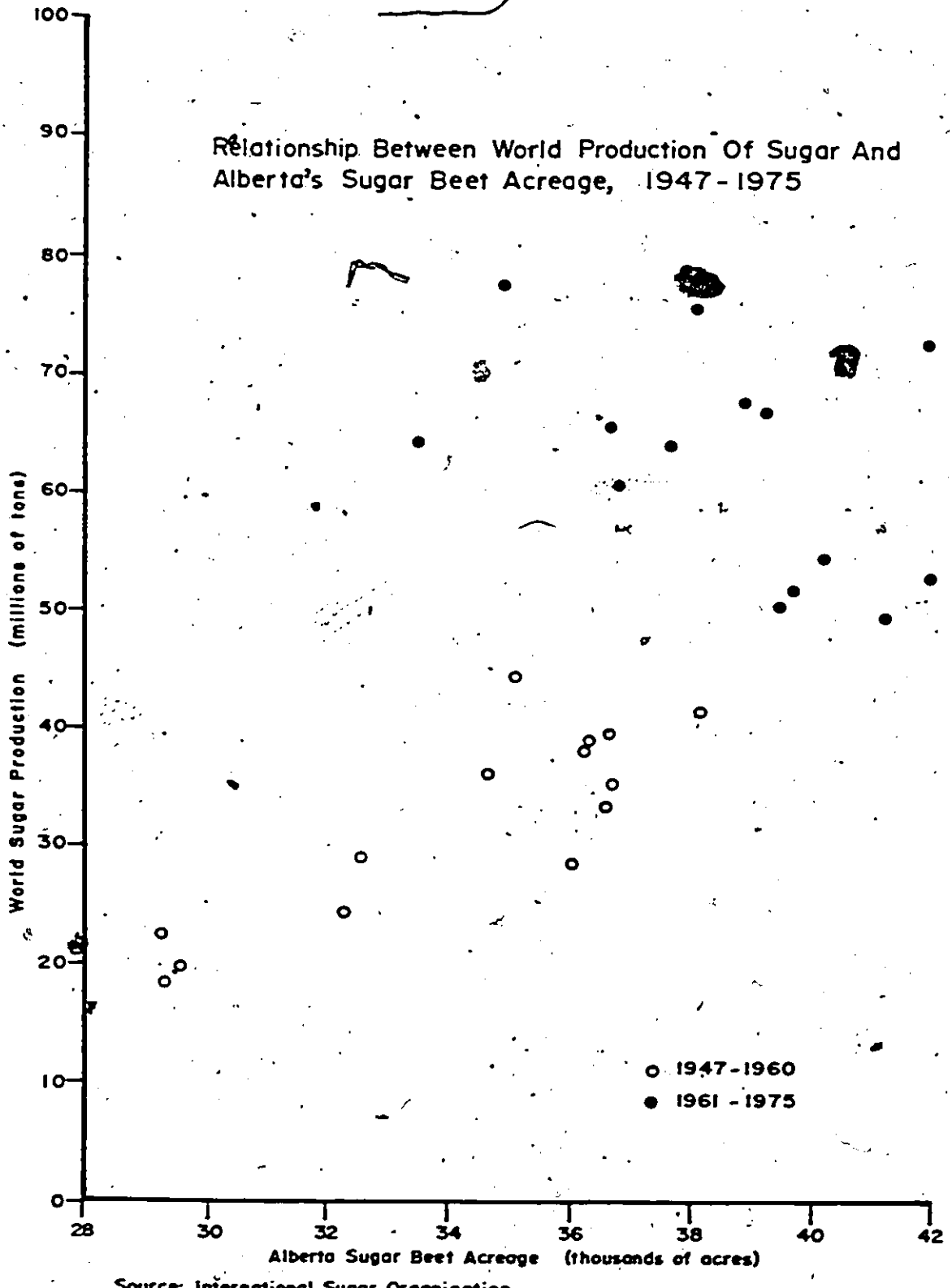
Source: International Sugar Organization

APPENDIX II

Variables Influencing Sugar Beet Acreage in Alberta

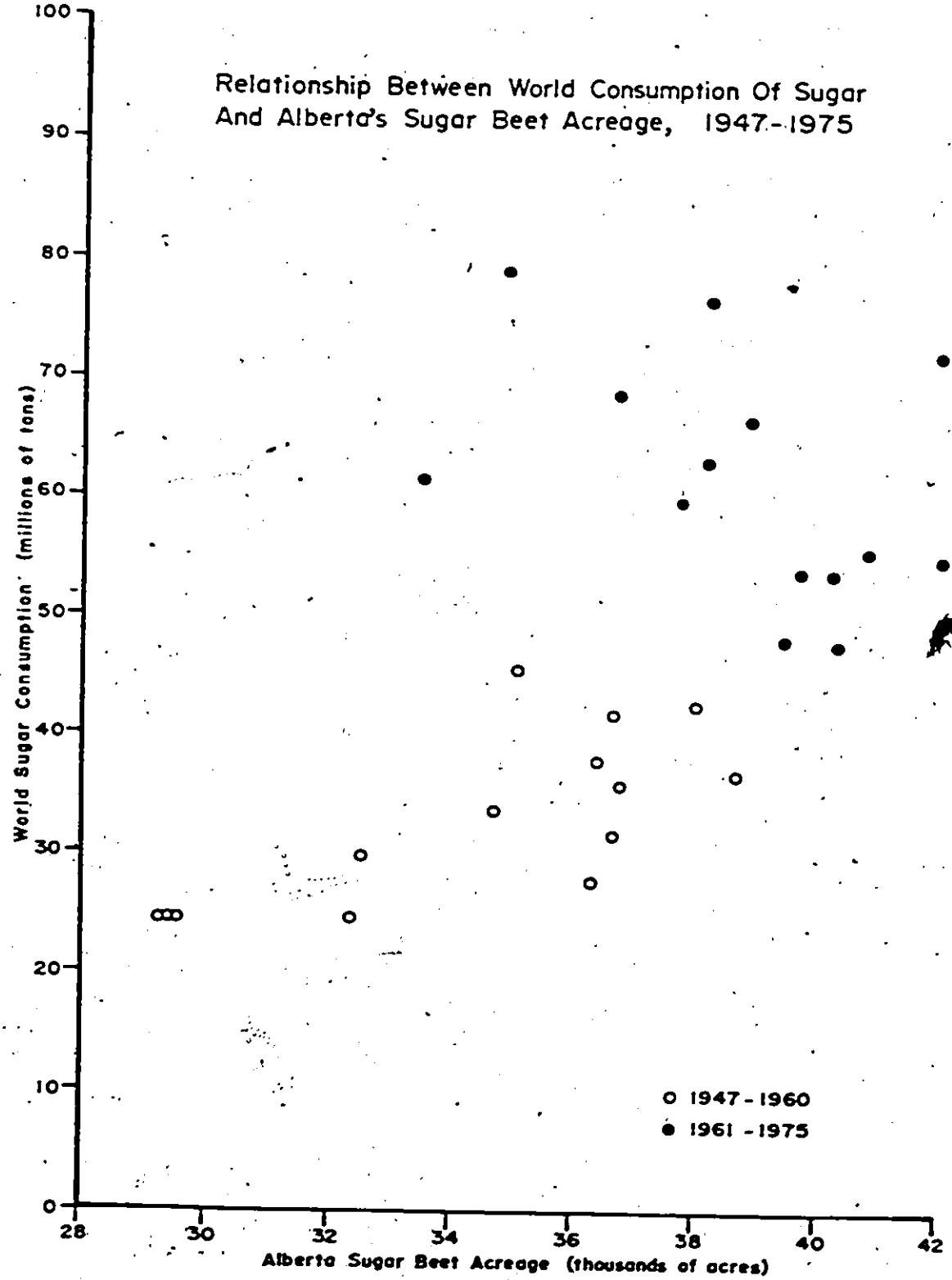
FIGURE 12

Relationship Between World Production Of Sugar And Alberta's Sugar Beet Acreage, 1947 - 1975



Source: International Sugar Organization

FIGURE 13



Source: International Sugar Organization

FIGURE 14

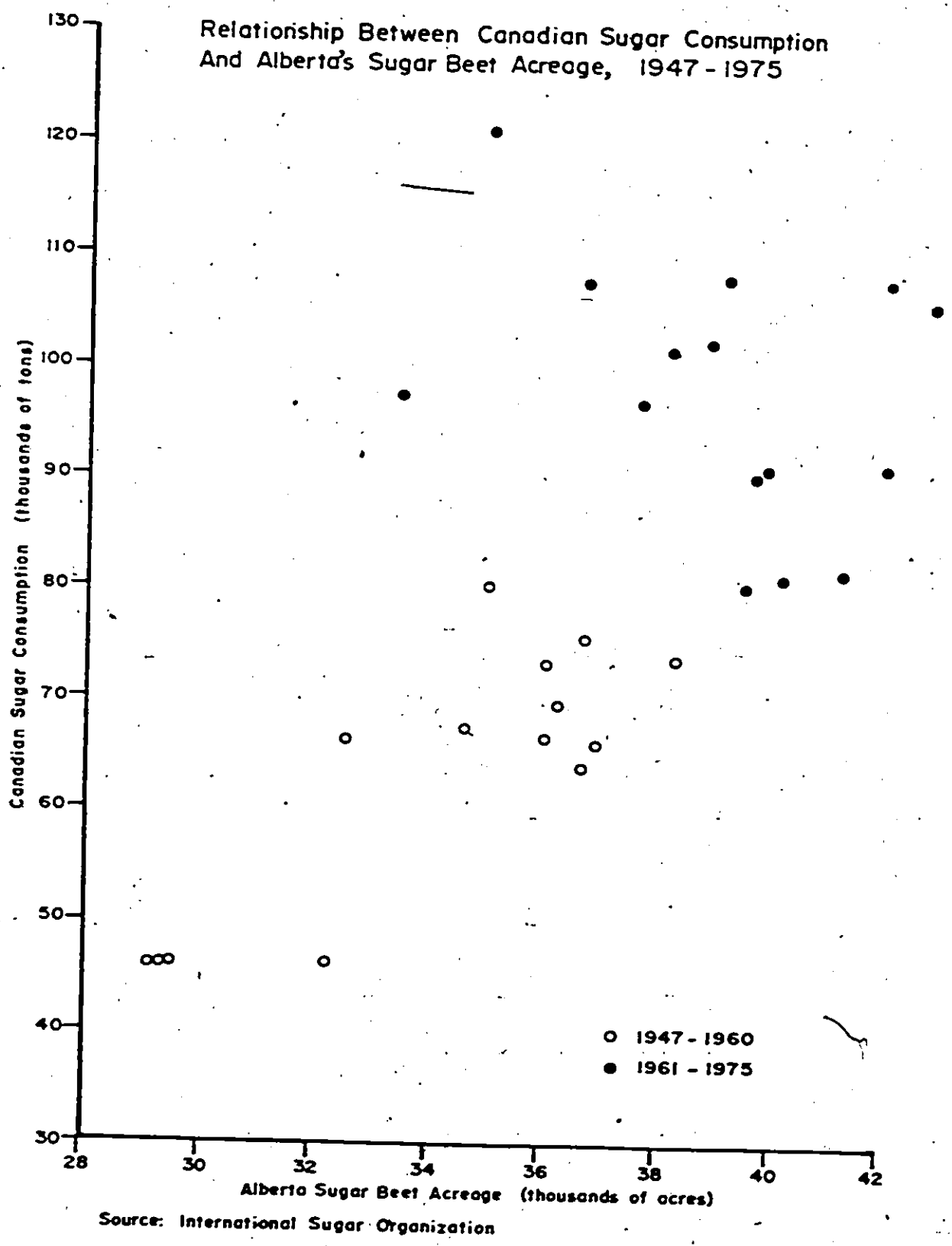
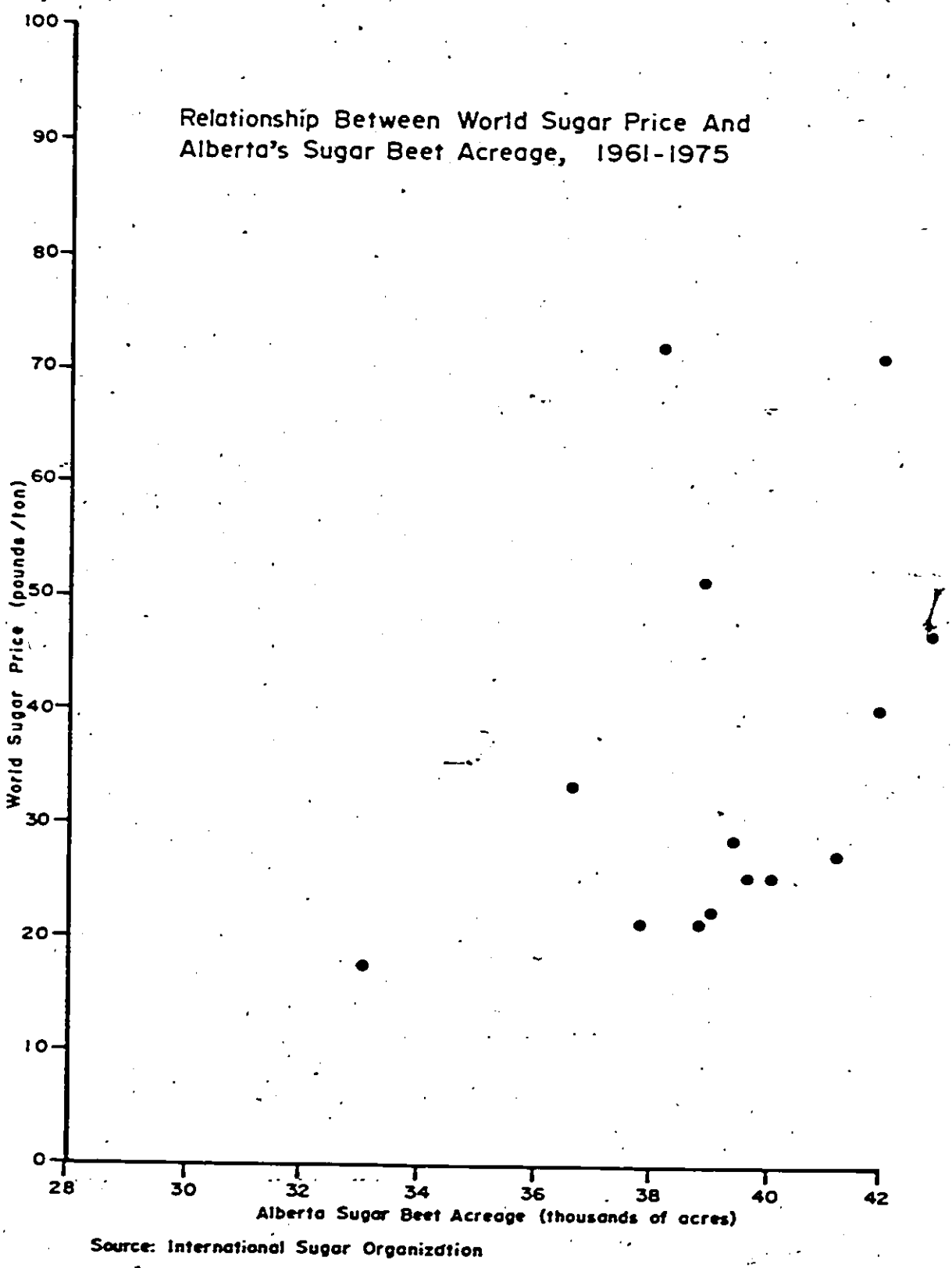

Relationship Between Canadian Sugar Consumption
And Alberta's Sugar Beet Acreage, 1947 - 1975
Canadian Sugar Consumption (thousands of tons)
130
120
110
100
90
80
70
60
50
40
30
28
30
32
34
36
38
40
42
Alberta Sugar Beet Acreage (thousands of acres)
1947 - 1960
1961 - 1975
Source: International Sugar Organization

FIGURE 15



Source: International Sugar Organization

FIGURE 16

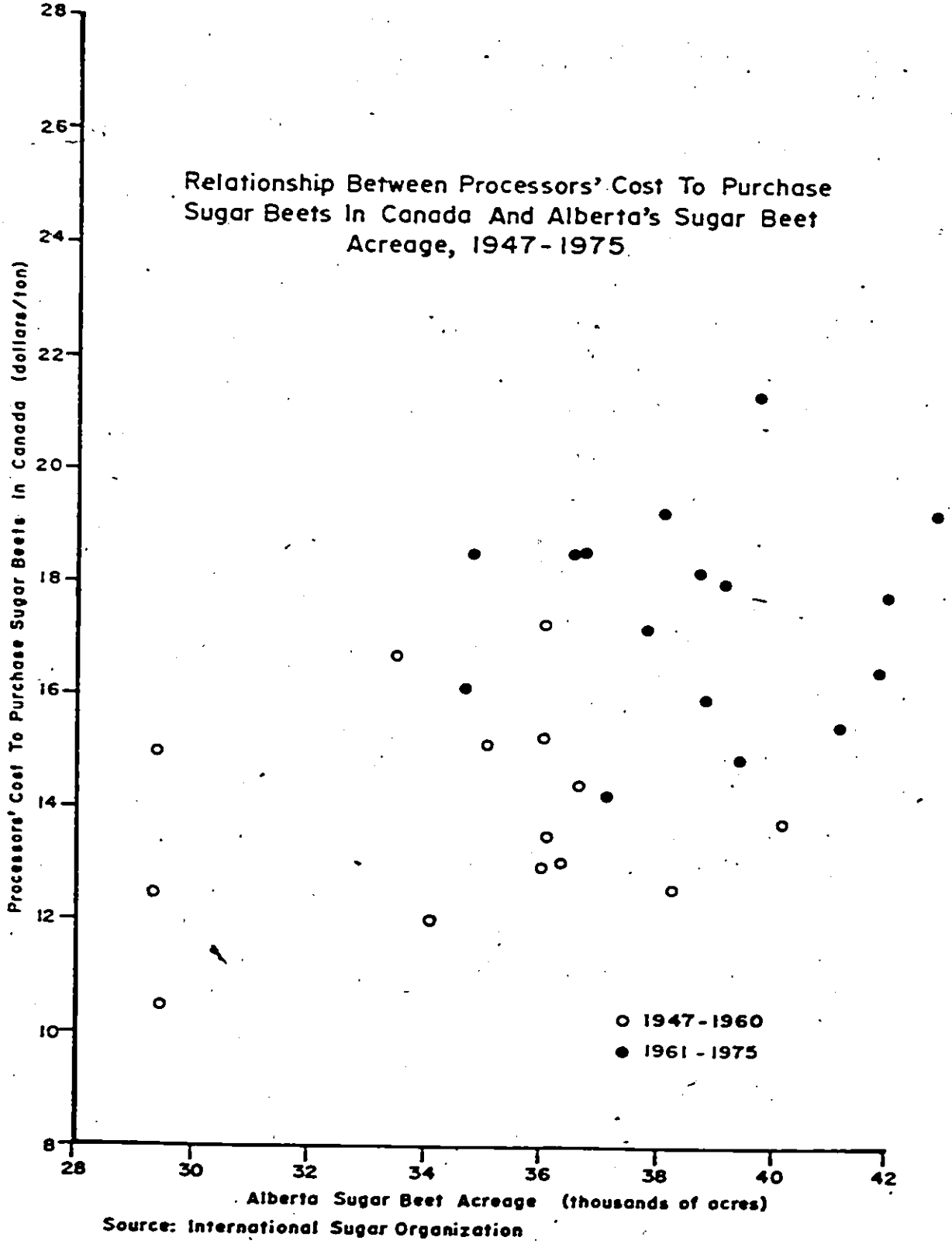
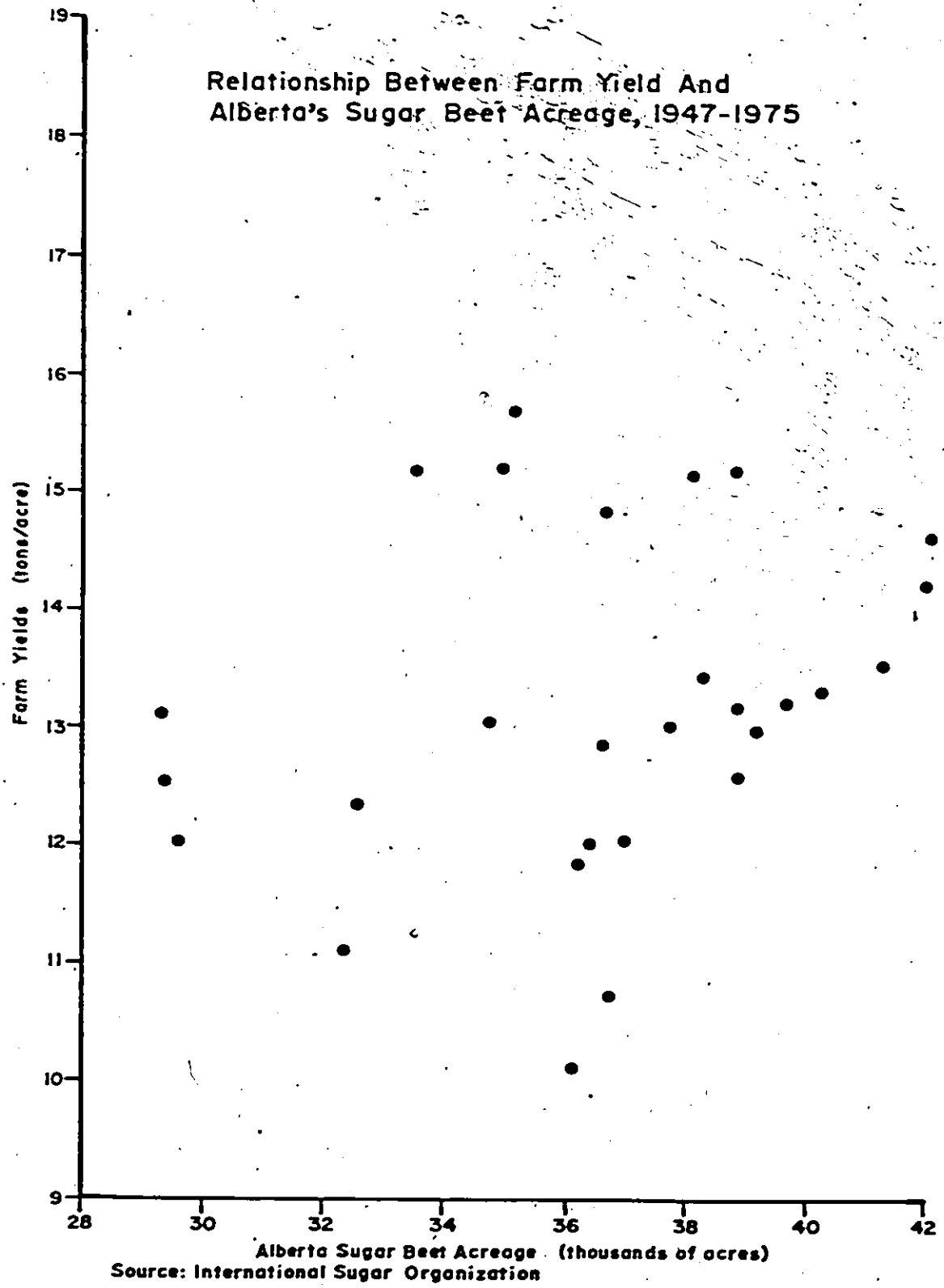

Relationship Between Processors' Cost To Purchase Sugar Beets In Canada And Alberta's Sugar Beet Acreage, 1947-1975
Processors' Cost To Purchase Sugar Beets In Canada (dollars/ton)
28
26
24
22
20
18
16
14
12
10
8
28
30
32
34
36
38
40
42
Alberta Sugar Beet Acreage (thousands of acres)
1947-1960
1961-1975
Source: International Sugar Organization

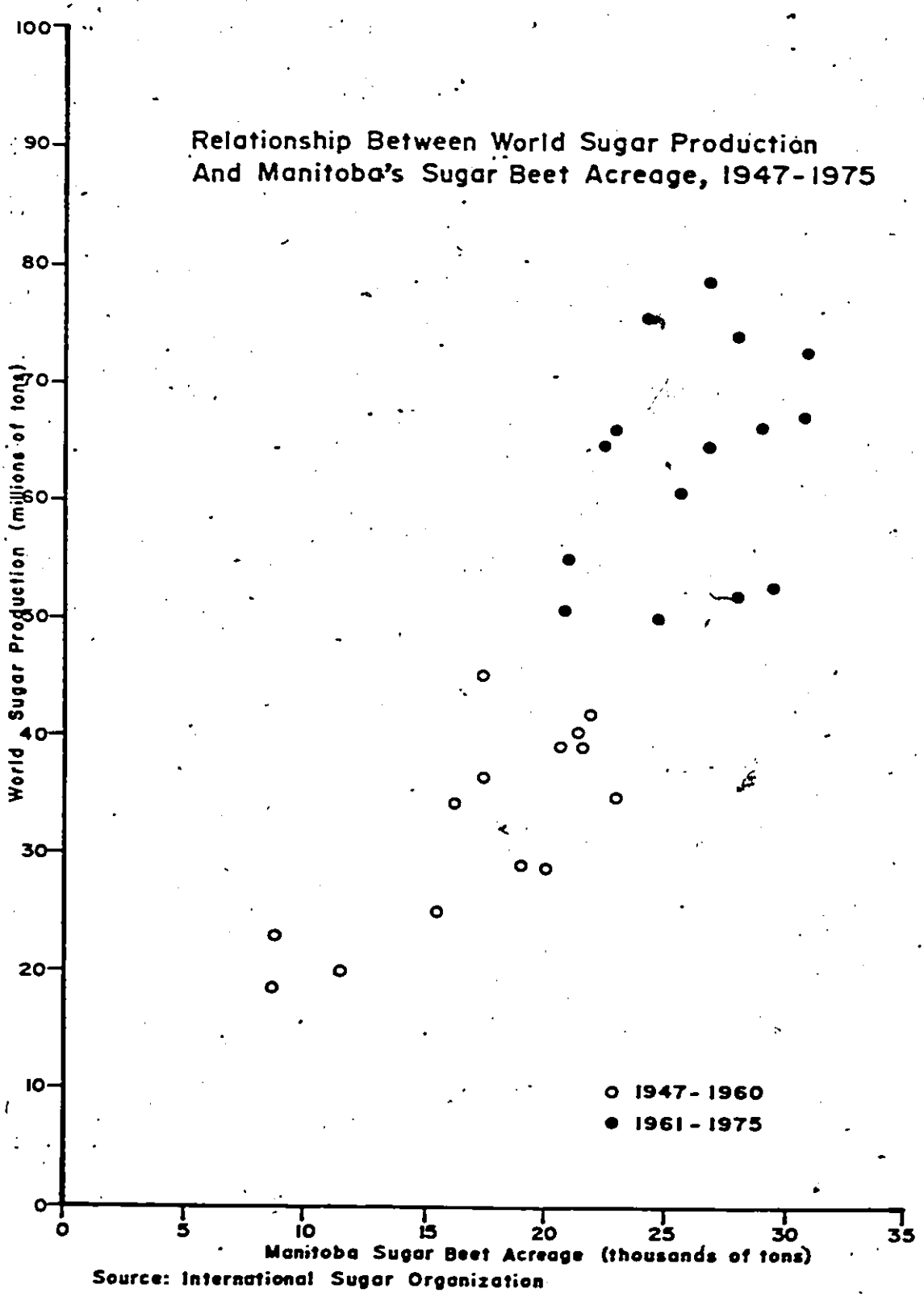
FIGURE 17


Relationship Between Farm Yield And
Alberta's Sugar Beet Acreage, 1947-1975
Farm Yields (tons/acre)
19
18
17
16
15
14
13
12
11
10
9
28
30
32
34
36
38
40
42
Alberta Sugar Beet Acreage (thousands of acres)
Source: International Sugar Organization

APPENDIX III

Variables Influencing Sugar Beet Acreage in Manitoba

FIGURE 18



Source: International Sugar Organization

FIGURE 19

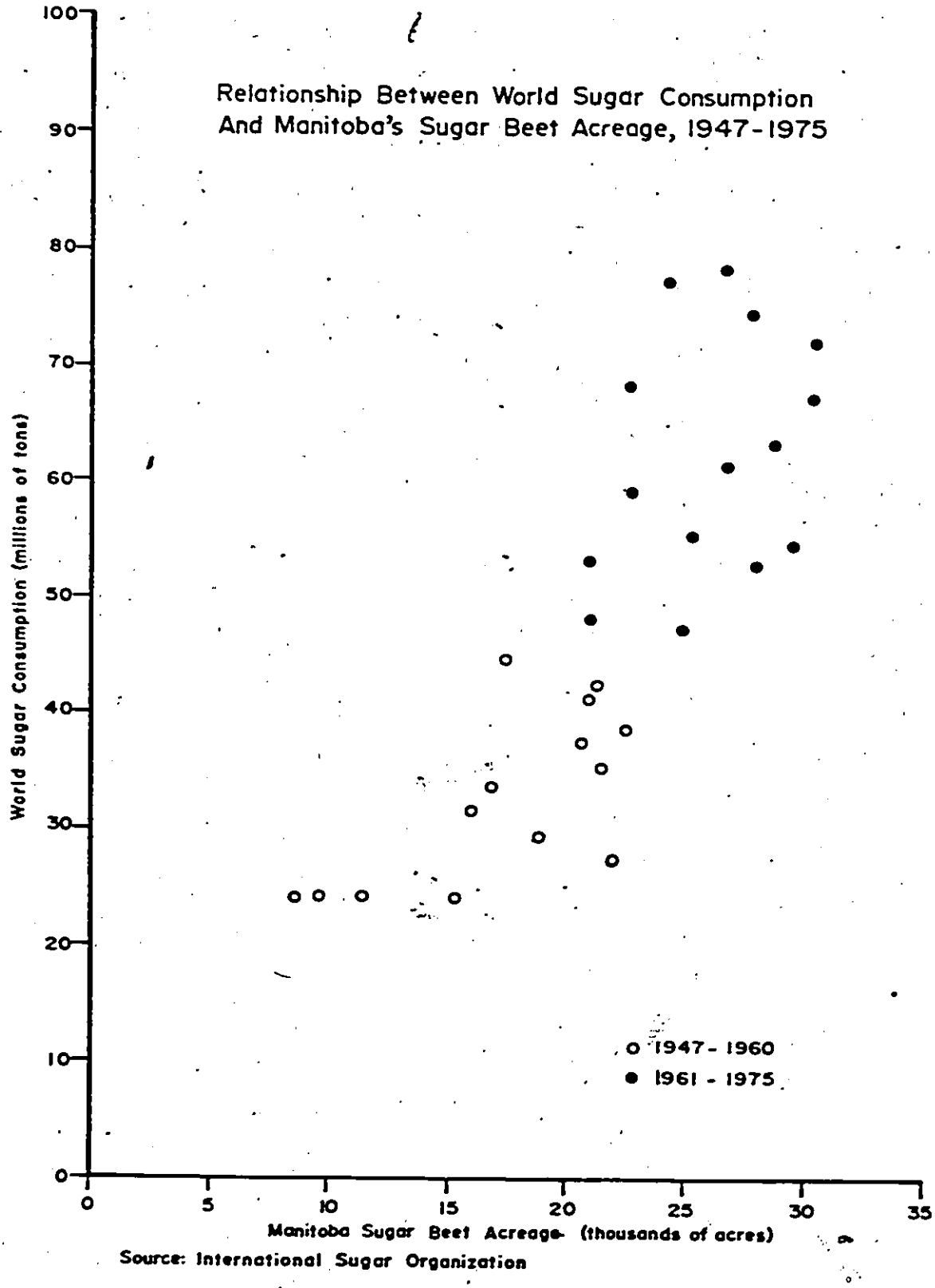
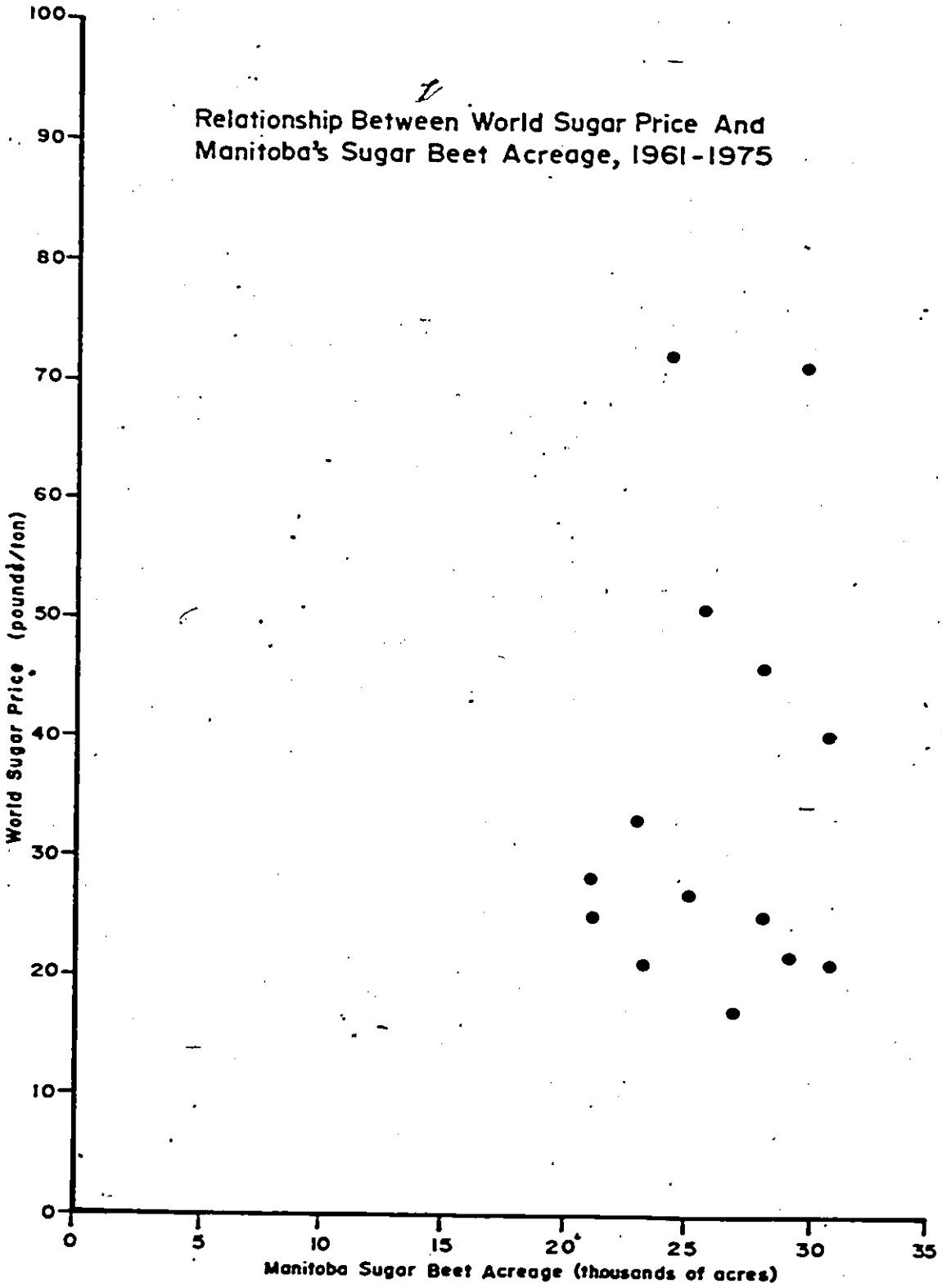

Relationship Between World Sugar Consumption
And Manitoba's Sugar Beet Acreage, 1947-1975
World Sugar Consumption (millions of tons)
100
90
80
70
60
50
40
30
20
10
0
0
5
10
15
20
25
30
35
Manitoba Sugar Beet Acreage (thousands of acres)
o 1947 - 1960
● 1961 - 1975
Source: International Sugar Organization

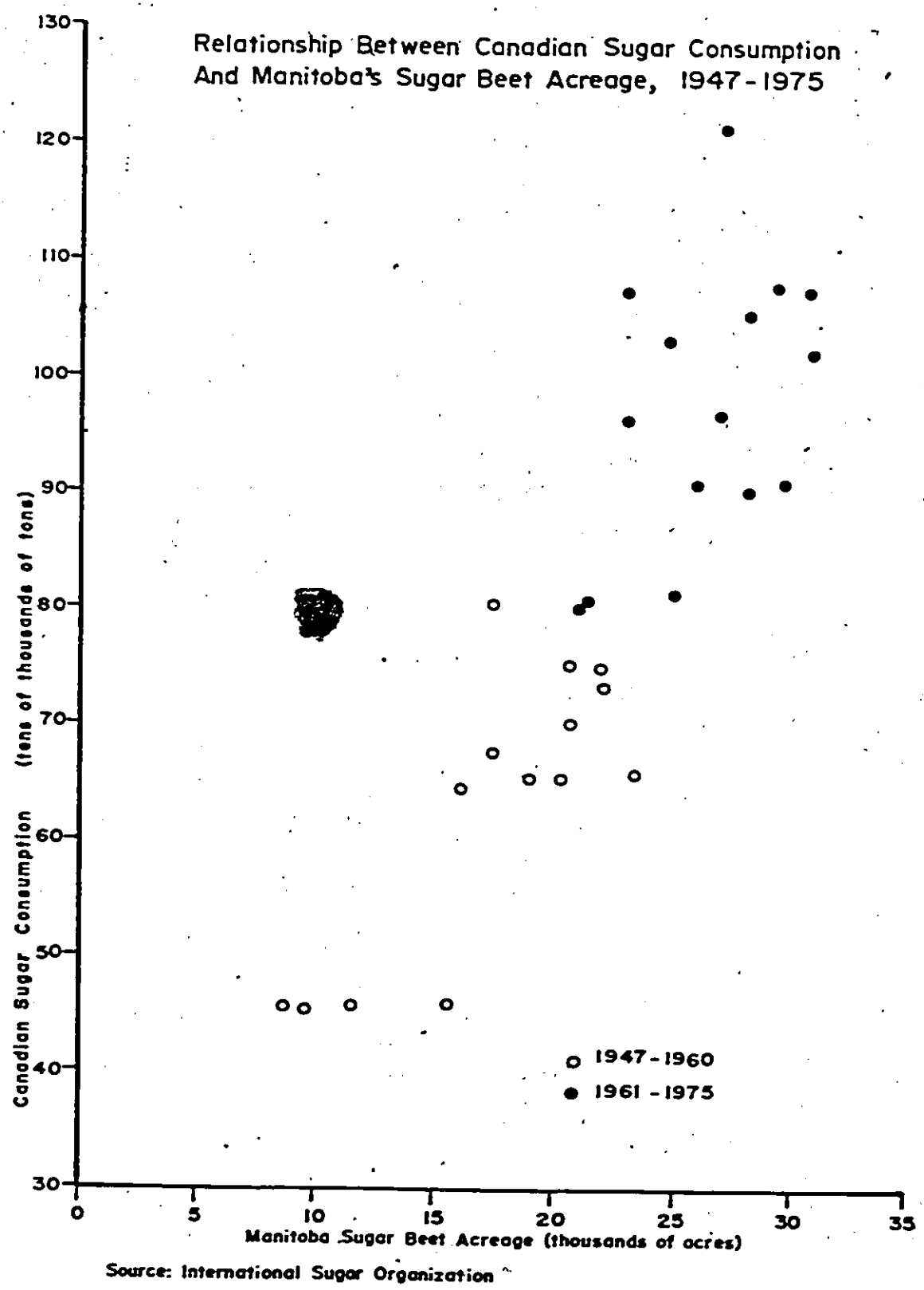
FIGURE 20

Relationship Between World Sugar Price And Manitoba's Sugar Beet Acreage, 1961-1975



Source: International Sugar Organization

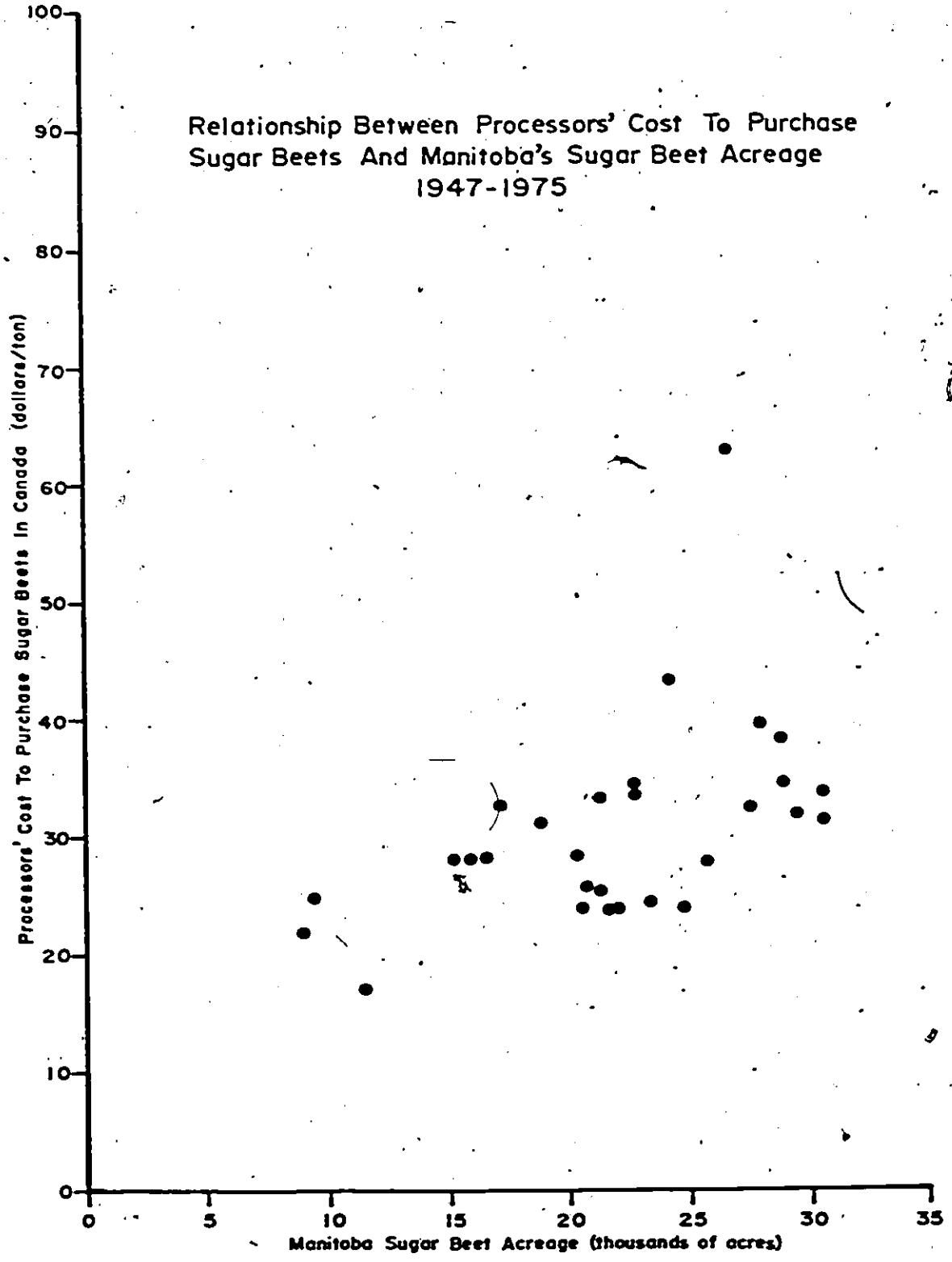
FIGURE 21



Source: International Sugar Organization

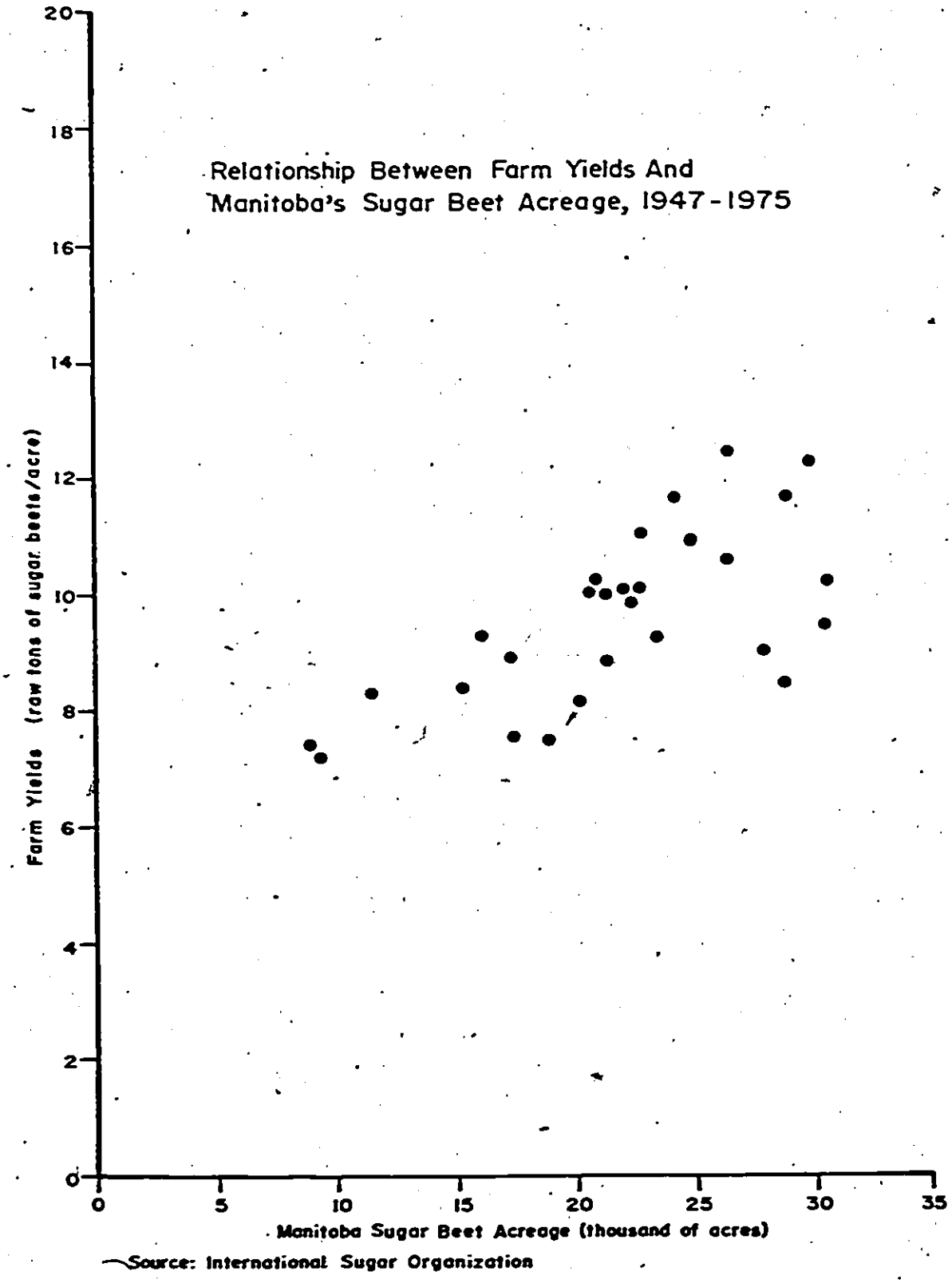
FIGURE 22

Relationship Between Processors' Cost To Purchase Sugar Beets And Manitoba's Sugar Beet Acreage 1947-1975



Source: International Sugar Organization

FIGURE 23


Relationship Between Farm Yields And
Manitoba's Sugar Beet Acreage, 1947-1975
Farm Yields (raw tons of sugar beets/acre)
0
2
4
6
8
10
12
14
16
18
20
0
5
10
15
20
25
30
35
Manitoba Sugar Beet Acreage (thousand of acres)
Source: International Sugar Organization

APPENDIX IV

Variables Influencing Sugar Beet Acreage in Quebec

FIGURE 24

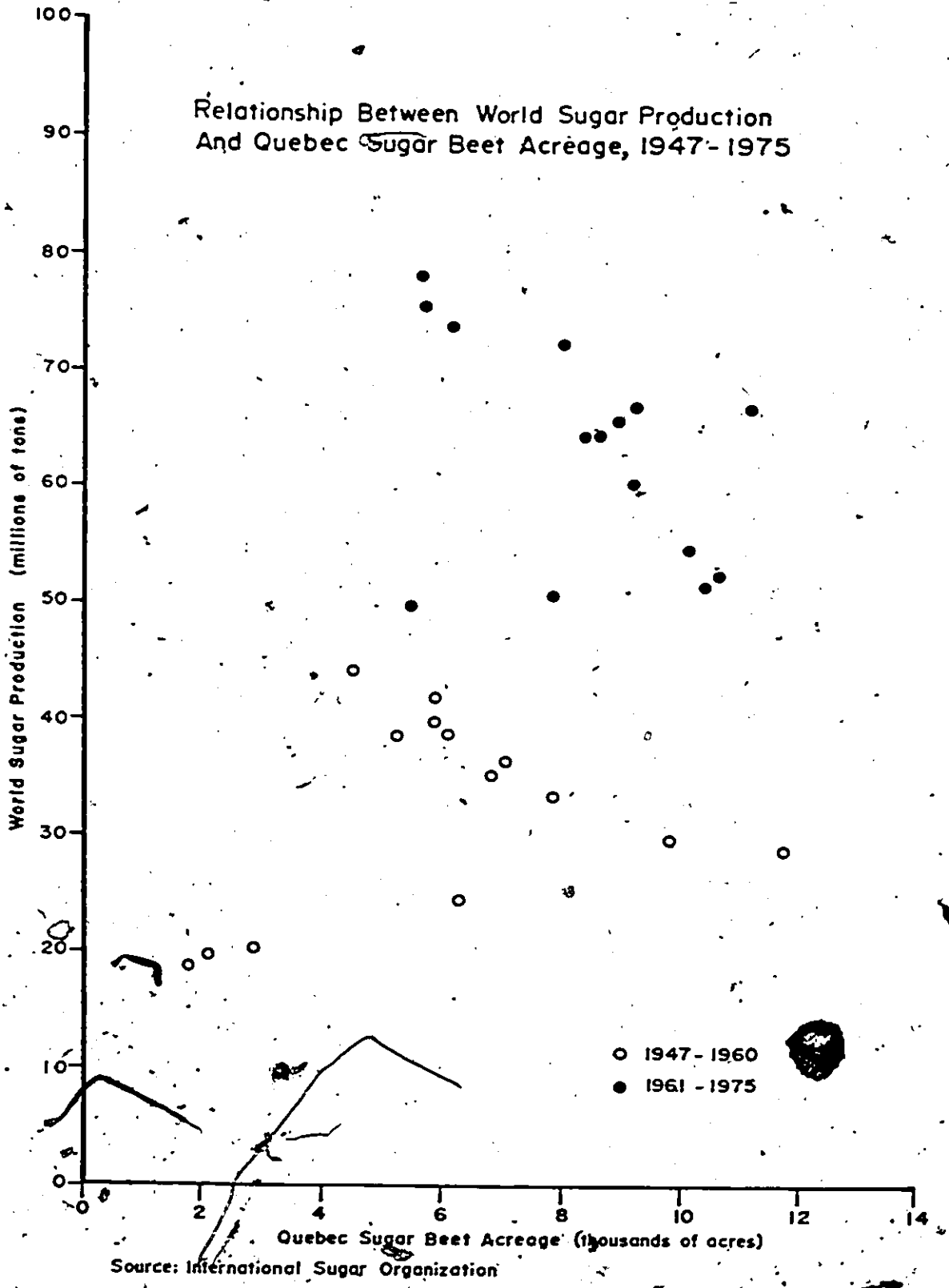

Relationship Between World Sugar Production
And Quebec Sugar Beet Acreage, 1947-1975
World Sugar Production (millions of tons)
100
90
80
70
60
50
40
30
20
10
0
0
2
4
6
8
10
12
14
Quebec Sugar Beet Acreage (thousands of acres)
1947-1960
1961-1975
Source: International Sugar Organization

FIGURE 25

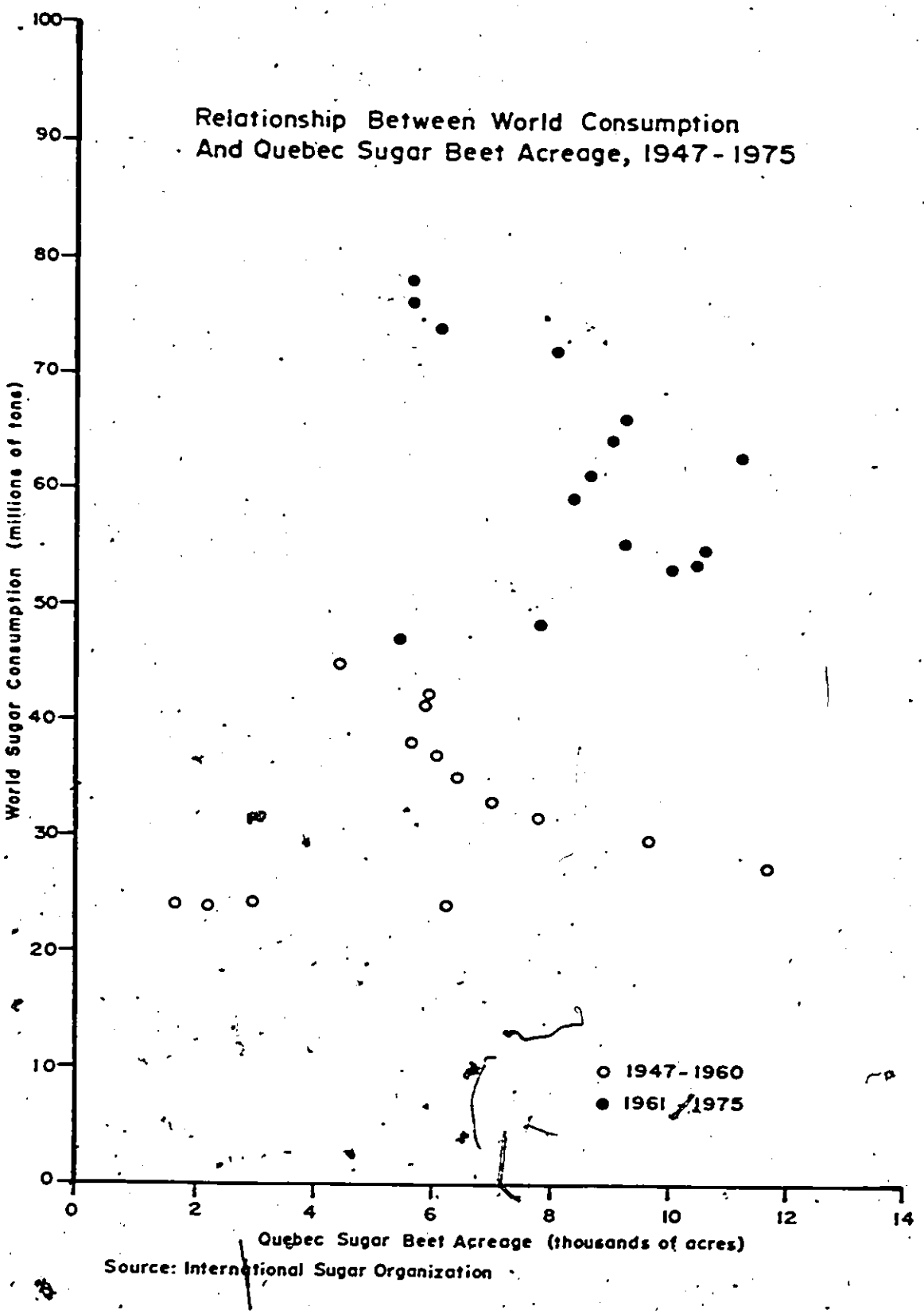
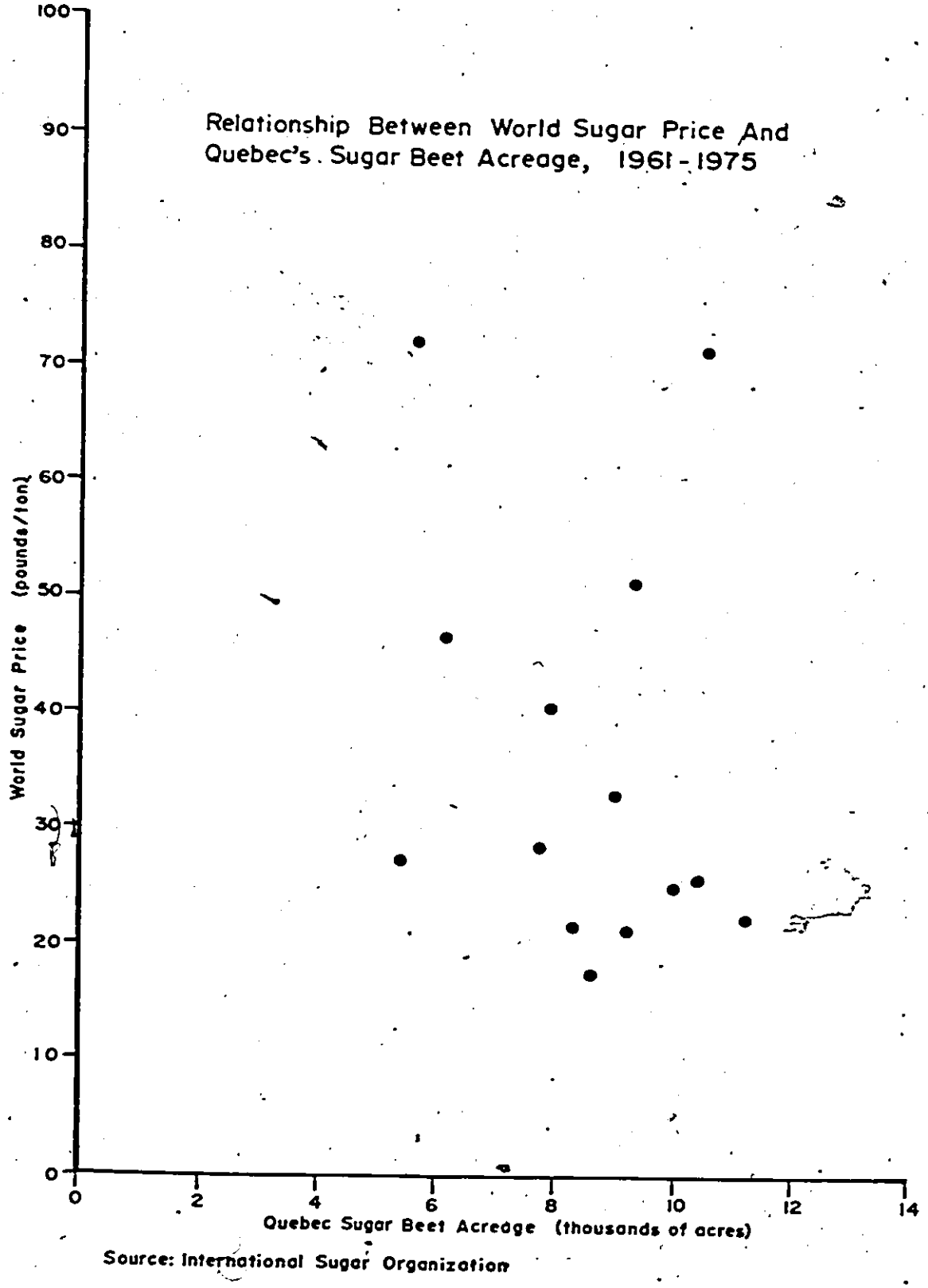
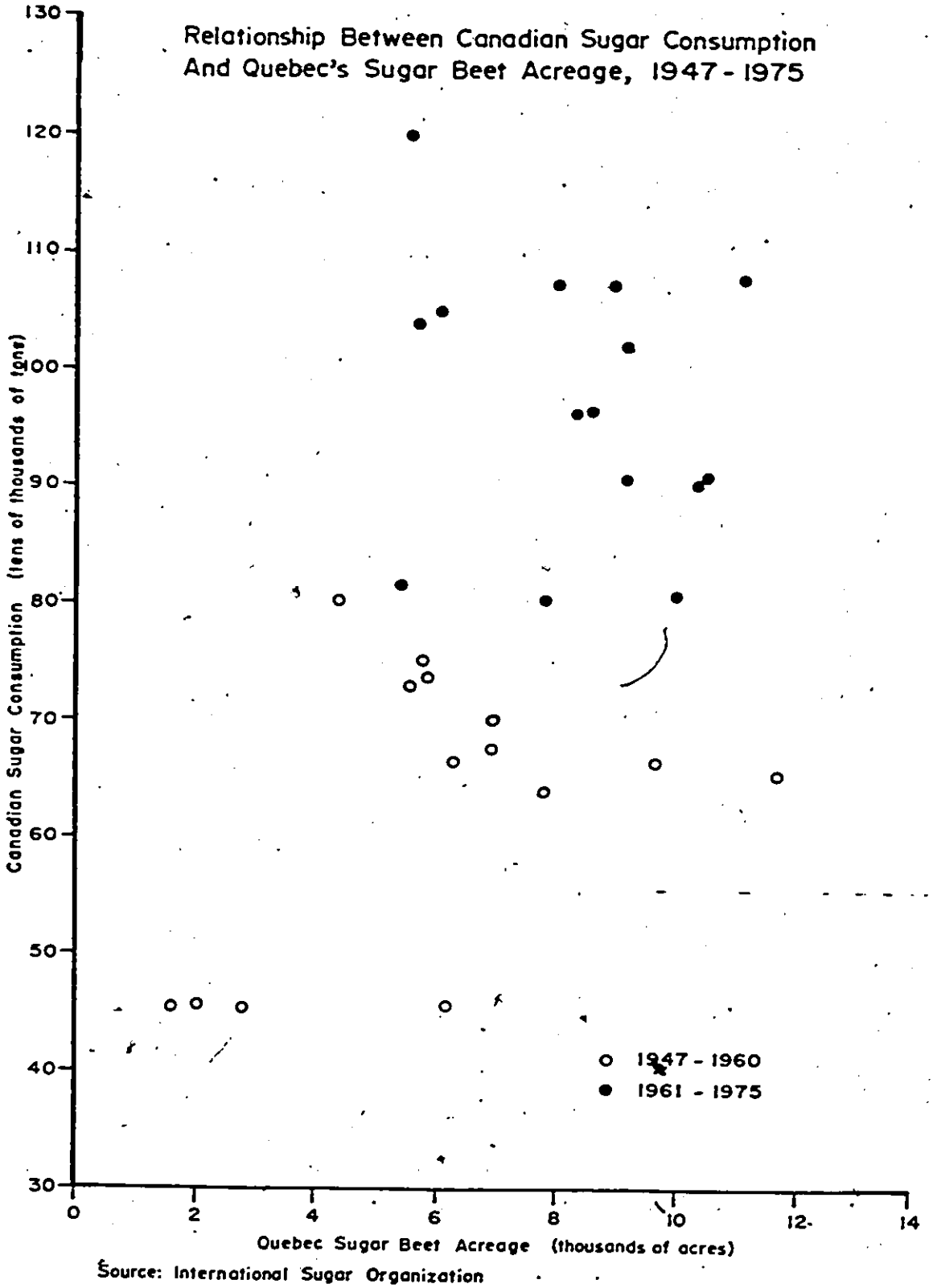

Relationship Between World Consumption
And Quebec Sugar Beet Acreage, 1947-1975
World Sugar Consumption (millions of tons)
100
90
80
70
60
50
40
30
20
10
0
0
2
4
6
8
10
12
14
Quebec Sugar Beet Acreage (thousands of acres)
1947-1960
1961-1975
Source: International Sugar Organization

FIGURE 26



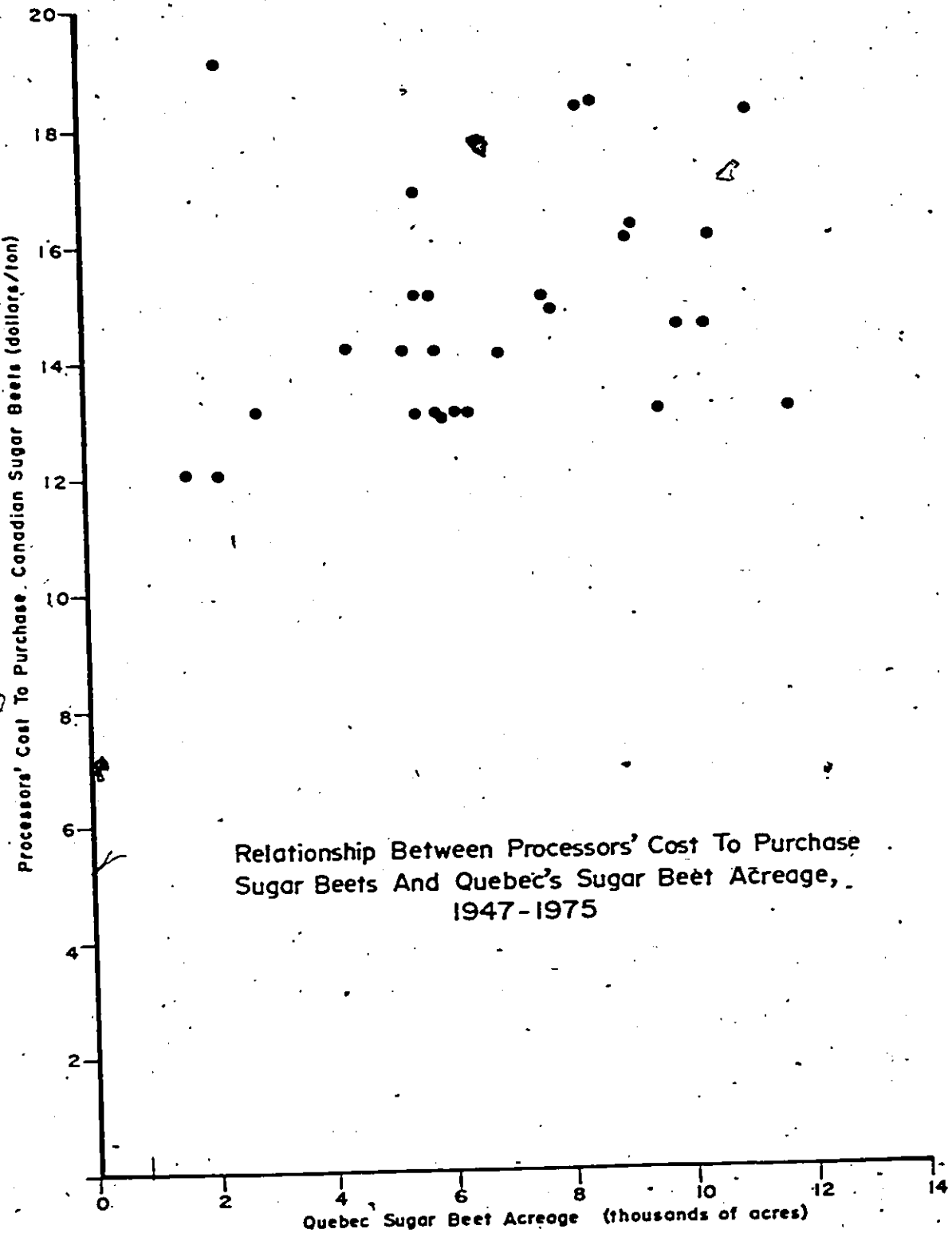
Source: International Sugar Organization

FIGURE 27



Source: International Sugar Organization

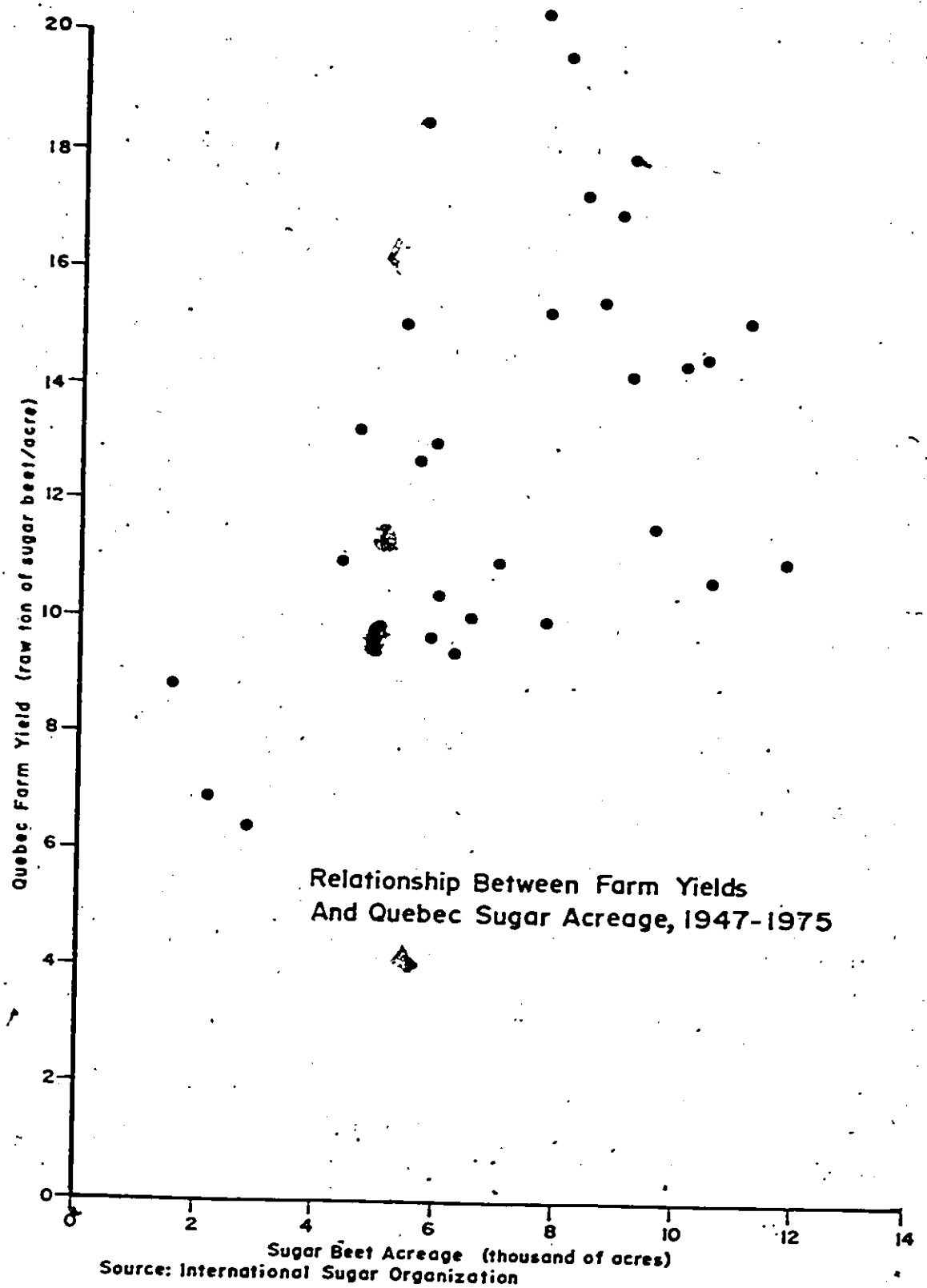
FIGURE 28



Relationship Between Processors' Cost To Purchase Sugar Beets And Quebec's Sugar Beet Acreage, 1947-1975

Source: International Sugar Organization

FIGURE 29



Relationship Between Farm Yields
And Quebec Sugar Acreage, 1947-1975

Source: International Sugar Organization

APPENDIX V

Correlation Coefficients For Canada, Alberta, Manitoba and Quebec

Coefficients of Correlation

Canadian Sugar Beet Acreage With Independent Variables

Independent Variable	Correlation Coefficient 1947-1960	Statistically Significant	Correlation Coefficient 1961-1975	Statistically Significant	Level of Significance
World Sugar Production	+0.62	at .05 level	-0.78	Yes	.01
World Sugar Consumption	+0.56	at .05 level	-0.75	Yes	.01
World Sugar Price	-	-	-0.27	No	-
Canadian Sugar Consumption	+0.69	at .05 level	-0.68	Yes	.01
Federal Subsidy	-	-	-0.20	No	-
Processor's Cost to Purchase Sugar Beets	-	-	-0.34	No	-
Farm Yields	+0.24	No	-0.18	No	-

Degrees of freedom = N-2 = 12

Degrees of freedom = N-2 = 13

Coefficients of Correlation

Alberta Sugar Beet Acreage With Independent Variables

Independent Variable	Correlation Coefficient 1947-1960	Statistically Significant	Correlation Coefficient 1961-1975	Statistically Significant	Level of Significance
World Sugar Production	+0.86	Yes at .001 level	+0.29	No	-
World Sugar Consumption	+0.77	Yes at .01 level	+0.22	No	-
World Sugar Price	-	-	+0.06	No	-
Canadian Sugar Consumption	+0.85	Yes at .001 level	+0.29	No	-
Processor's Cost to Purchase Sugar Beets	-0.05	No	+0.23	No	-
Farm Yields	+0.35	No	-0.10	No	-

Degrees of freedom = N-2 = 23 Degrees of freedom = N-2 =13

Coefficients of Correlation

Manitoba Sugar Beet Acreage with Independent Variables

Independent Variable	Correlation Coefficient 1947-1960	Statistically Significant	Correlation Coefficient 1961-1975	Statistically Significant	Level of Significance
World Sugar Production	+0.76	Yes at .01 level	+0.30	No	-
World Sugar Consumption	+0.82	Yes at .01 level	+0.3	No	-
World Sugar Price	-	-	+0.14	No	-
Canadian Sugar Consumption	+0.81	Yes at .01 level	+0.46	No	-
Processor's Cost to Purchase Sugar Beets			+0.23	No	-
Farm Yields	+0.50	No	+0.04	No	-

Degrees of freedom = N-2 =12

Degrees of freedom = N-2 = 13

Coefficients of Correlation

Quebec Sugar Beet Acreage with Independent Variables

Independent Variable	Correlation Coefficient 1947-1960	Statistically Significant	Correlation Coefficient 1961-1975	Statistically Significant	Level of Significance
World Sugar Production	+0.30	No	-0.39	No	-
World Sugar Consumption	+0.11	-	-0.24	No	-
World Sugar Price	-	-	-0.38	No	-
Canadian Sugar Consumption	+0.68	Yes at .01 level	-0.20	No	-
Processor's Cost to Purchase Sugar Beets	-	-	+0.38	No	-
Farm Yields	+0.59	Yes at .05 level	-0.31	No	-

Degrees of freedom = N-2 =12

Degrees of freedom = N-2 - 13

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